

finfish



I. The Finfish of Chincoteague Bay

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INTRODUCTION

Estuaries and salt marshes are widely recognized as areas of high productivity and as nursery areas for many species of both vertebrates and invertebrates. McHugh (1966) listed over 40 species of fishes and other organisms that are estuarine dependent and stated that well over half of our domestic commercial fish catch is based on estuarine dependent species. Chincoteague Bay, with a mean depth of 4 feet and extensive shallow flats that support large and expanding beds of eel grass (Zostera marina) and widgeon grass (Ruppia maritima), is a fertile nursery ground for many species of fish and many kinds of invertebrates. Schwartz (1961) conducted an extensive survey of the fishes of Chincoteague and Sinepuxent bays and reviewed the literature which records fishes from those bays. He recorded 65 species by his own collecting efforts and compiled a list from the literature for a total of 99 species recorded since 1876. The purpose of this study is to qualitatively assess the present species composition of the fish populations of Chincoteague Bay with emphasis on the proposed dredging areas in Chincoteague Bay adjacent to Assateague Island

METHODS

Most collections were made with a 50-foot bag seine, 6 feet deep with a 1/4-inch woven mesh. A few collections were made also with smaller 10 and 20-foot minnow seines of 4-foot depth with 1/4-inch woven mesh.

Trawl samples were also taken; one series with a 25-foot semi-balloon otter trawl with a 1/4-inch woven mesh liner in the cod end, one series with a 10-foot semi-balloon otter trawl with a 1/8-mesh in the cod end, and one series with a 30-inch beam trawl with 1/4-inch woven mesh. In each haul the catch was examined and specimens of all the species collected were preserved in 10% formalin except for very large fishes, too large to fit into the collecting jars. These were discarded, their number and species noted on field notes. Eight regular seining stations were established in or adjacent to the three proposed dredge sites. Collections were made at these stations at least once during each of the four seasons. A few other seine stations in the vicinity of Pope Bay were also established, some seine collections were made in several of the fresh water ponds on Assateague Island, and trawl stations were made in deeper waters of Chincoteague and Sinepuxent Bays. The localities are described in Table 1 and shown in Fig. 1. For comparative purposes, three trawl collections were made from borrow areas in Isle of Wight Bay, west of Ocean City.

Although the collections were not made in a quantitative manner, the numbers of specimens indicated in this report are somewhat indicative of the relative abundance of various species collected. When only a few specimens of a particular species were collected, in general, all were preserved but for very abundant species small sub-samples of the entire collection were preserved.

A series of maps, showing localities where collected and season of occurrence for each species of fish taken in this study, is presented at the end of this report.

ANNOTATED LIST OF FISH SPECIES

DASYATIDAE -- Stingrays.

Dasyatis americana Hildebrand & Schroeder. Southern stingray. Fig. 2.

A total of 6 specimens ranging in size from 1 1/2 to 2 1/2 feet across the wing tips were taken in this study. They were taken in the shallow sandy waters of seine stations 4, 8, 14, and 16. All were collected during late spring or summer in the months of June, July, and August.

MYLIOBATIDAE -- Eagle rays.

Rhinoptera bonasus (Mitchill). Cownose ray. Fig. 31.

One specimen about 2 1/2 feet across the wing tips was taken in water about 2 to 4 feet deep over muddy sandy bottom on 24 June 1970 at seine station 1.

CLUPEIDAE -- Herrings.

Clupea harengus Linnaeus. Atlantic herring. Fig. 31.

One juvenile specimen, 82 mm TL, was taken at about 3 1/2 feet of water on 10 May 1970 at station 5. Six larvae were taken 9 March 1970 by beach seining at station 10. The presence of larvae and juvenile fish in Chincoteague Bay indicates that Atlantic herring are reproducing in Chincoteague Bay, at least to a limited extent.

Brevoortia tyrannus (Latrobe). Atlantic menhaden. Fig. 3

Many juveniles were caught during spring and summer in the southern part of the study area, including seine stations 1, 5, 7, 8, and 14-16

ENGRAULIDAE -- Anchovies.

Anchoa mitchilli (Valenciennes). Bay anchovy. Fig. 4.

Specimens were collected at one time or another from all of the eight regular seine stations and from most of the other collecting sites in Chincoteague

Bay. The only collecting period when bay anchovies were not taken was during 9-10 March 1970.

ANGUILLIDAE -- Freshwater eels.

Anguilla rostrata (Lesueur). American eel. Fig. 5

American eels are present at all seasons in Chincoteague Bay and were taken at seining stations 1-8, and 15 and by trawl at station 10. On 10 March 1970, an elver (glass eel) was taken at station 6 and two more were taken 9 May 1970 at station 8. Other individuals ranged in size from small juveniles to about 2 1/2 feet.

CONGRIDAE -- Conger eels.

Conger oceanicus (Mitchill). Conger eel. Fig. 31.

One specimen 355 mm TL was taken at otter trawl station 8 one mile east of Robbin's Marsh in water 6 feet deep. Salinity was 29.6 ppt, water temperature 21.2 C, the date 1 October 1969. This is the first time that this species has been reported from Chincoteague Bay.

BELONIDAE -- Needlefishes.

Strongylura marina (Walbaum). Atlantic needlefish. Fig. 6.

Young needlefish were collected at many seine stations during spring and summer, including stations 1, 2, 3, 7, 8, 13, 14, and 16. Specimens as small as 86 mm TL were taken. This indicates that this species probably reproduces in Chincoteague Bay.

EXOCOETIDAE-- Halfbeaks.

Hyporhamphus sp. Halfbeak. Fig. 31.

A female 206 mm TL was collected at seine station 2 on 9 May 1970. This is the first record of this species from Chincoteague Bay. Schwartz (1964)

recorded Hemiramphus sp. from Isle of Wight Bay and stated that it occurred there in schools. Schwartz referred to a revision of the Atlantic halfbeaks that is now being done by Bruce B. Collette as his reason for not giving specific identification of his fishes. It is probable, however, that the genus he intended to cite was Hyporhamphus and not Hemiramphus.

CYPRINODONTIDAE -- Killifishes.

Cyprinodon variegatus Lacépède. Sheepshead minnow. Fig. 7.

This species probably occurs in all protected shallow inshore waters of Chincoteague Bay. It has been taken at seine stations 3, 5-10, 12, 13, 15-16, and in the fresh water pond stations 2 and 4 on Assateague Island.

Fundulus diaphanus (Lesueur). Banded killifish. Fig. 8.

This killifish is commonly found in the fresher portions of estuaries. It has not previously been reported from Chincoteague Bay but it is probably present in all the more fresh-water portions of the tributary creeks of Chincoteague Bay. It was collected from fresh-water pond stations 1 and 4 on Assateague Island. Schwartz (1964) reported that the banded killifish occurred in large schools in Assawoman Bay.

Fundulus heteroclitus (Linnaeus). Mummichog. Fig. 9.

Schwartz (1961) lists this as the most abundant cyprinodontid throughout the bay. It was taken in almost all the inshore shallow water stations and in all the fresh-water ponds that were sampled except station 4.

Fundulus majalis (Walbaum). Striped killifish. Fig. 10.

This killifish was taken only at seine stations 1, 3, 5, and 8. It was taken in abundance only at station 3 in August and October 1969.

Lucania parva (Baird)

Rainwater killifish. Fig. 11.

A few rainwater killifish were taken at various times at seine stations 1, 3, 4, 5, 6, 7, and in all the fresh-water ponds sampled. It is generally

associated with rooted aquatic vegetation and was taken abundantly only in fresh-water ponds.

GASTEROSTEIDAE -- Sticklebacks.

Apeltes quadracus (Mitchill). Fourspine stickleback. Fig. 12

The fourspine stickleback was taken at seine stations 1-4 and 6-8. Never taken anywhere in abundance, it is generally found associated with rooted aquatic vegetation. All the specimens that were collected, except one at station 8 in March, were taken in spring and summer.

Gasterosteus aculeatus Linnaeus. Threespine stickleback. Fig. 13.

One adult threespine stickleback was collected at seine station 1 in March 1970. On 9 May 1970, a single adult was collected at station 4 and 3 young-of-the-year and 6 adults (largest 70 mm TL) were taken from a shallow, algae-filled cove and from an isolated pool, near the cove, at station 8. On 8 May 1970, 56 young-of-the-year, 9-20 mm TL, were taken from an isolated, algae-filled pond on the island at station 5.

SYNGNATHIDAE -- Pipefishes and seahorses.

Hippocampus erectus Perry. Lined seahorse. Fig. 31.

One specimen was collected at seine station 1 on 29 July 1970.

Syngnathus fuscus Storer. Northern pipefish. Fig. 14.

The northern pipefish was collected at one time or another at seine stations 1, 2, 4-9, and 15, and at trawl stations 7, 8, and 9. It is most commonly found associated with rooted aquatic vegetation.

PERCICHTHYIDAE -- Temperate basses

Morone americana (Gmelin). White perch. Fig. 31.

One specimen was taken 6 July 1970 at seine station 15.

POMATOMIDAE -- Bluefishes.

Pomatomus saltatrix (Linnaeus). Bluefish. Fig. 15.

A total of 4 juvenile bluefish were taken in this study; one each in the spring at seine stations 1, 5, and 8 and another in the summer at seine station 1.

CARANGIDAE -- Jacks, scads, and pompanos.

Caranx hippos (Linnaeus). Crevalle jack. Fig. 31.

One young specimen 56 mm TL was collected 24 June 1970 at seine station 1. This specimen constitutes the first record of this species in Chincoteague Bay. Selene vomer (Linnaeus). Lookdown. Fig. 31.

One specimen was collected at seine station No. 1 on 29 July 1970.

Trachinotus falcatus (Linnaeus). Permit. Fig. 31.

One young specimen 55 mm TL was collected 5 August 1969 at seine station 3.

This is the first report of the permit in Chincoteague Bay. The permit is a tropical species but the young have been known to travel as far northward as Massachusetts.

SCIAENIDAE -- Drums.

Bairdiella chrysura (Lacépède). Silver perch. Fig. 16.

Silver perch were taken from seine stations 1, 2, 5-9, 15, and 16, and at trawl stations 7-11. They were taken most abundantly in late summer at the same stations but were also well represented in the fall collection. Only two were taken in a spring collection at station 1.

Cynoscion regalis (Bloch and Schneider). Weakfish. Fig. 17

This species is not common in the study area. One specimen was taken at seine station 1 in August 1969 and several others were taken at trawl stations 7, 8, 10, and 11 in October 1969. According to Schwartz (1961) weakfish are

very abundant in Sinepuxent Bay in August and September. It may be that they customarily inhabit water deeper than that sampled by seining and were thus not available.

Leiostomus xanthurus Lacépède. Spot. Fig. 18.

Schwartz (1961) listed spot as the second most abundant species in Chincoteague Bay. Single individuals were taken at seine stations 1, 3, and 6, and single specimens were taken at two different times at station 7. All of the 25-foot trawl stations had two or three spot in them. The scarcity of spot in the seining collections is probably due to their habit of staying in deeper water where they are inaccessible to the seine.

GOBIIDAE - Gobies

Gobiosoma bosci (Lacépède). Naked goby. Fig. 19.

A single naked goby was collected each at seine station 1 in the spring and station 6 in the winter and 2 were collected at beam trawl station 8 in the fall. This species may be more abundant in the bay than the present collection would indicate because it customarily lives in shells or in crevices on the bottom and its habit of concealing itself would tend to make it unavailable to the collecting gear used in this study. It may be, however, that with the loss of living oysters in Chincoteague Bay due to MSX disease, that the populations of this fish have drastically declined.

Microgobius thalassinus (Jordan and Gilbert). Green goby. Fig. 20.

The green goby was taken at seine stations 5 and 6, at otter trawl stations 1 and 5, and beam trawl stations 7 and 8. It seems to prefer hard mud bottom. This is the first time that green goby has been reported in Chincoteague Bay.

TRIGLIDAE -- Searobins.

Prionotus evolans (Linnaeus). Striped searobin. Fig. 31.

A single specimen was collected at otter trawl station 3 on 1 October 1969.

BLENNIIDAE -- Combtooth blennies.

Chasmodes bosquianus (Lacépède). Striped blenny. Fig. 31

Only two striped blennies were taken in this study - one each at seine stations 1 and 8. The striped blenny is usually common on oyster reefs and it is apparently only a casual visitor in the study area.

MUGILIDAE -- Mulletts.

Mugil cephalus Linnaeus. Striped mullet. Fig. 31.

The striped mullet was taken at two seine stations, four each at stations 1 and 6, August 1969.

Mugil curema Valenciennes. White mullet. Fig. 21.

Young-of-the year white mullet were collected at seine stations 2, 3, 13 and 15.

ATHERINIDAE -- Silversides.

Membras martinica (Valenciennes). Rough silverside. Fig. 22.

The rough silverside was collected in spring and summer at stations 1, 2, 4, 5, and 7. It was never abundant and was usually taken in the same seine hauls with many Menidia menidia. This is the first time that the rough silverside has been recorded in Chincoteague Bay.

Menidia beryllina (Cope). Tidewater silverside. Fig. 23.

The tidewater silverside was present during all seasons in Chincoteague Bay and was collected at seining stations 1-3, 5-12, 12-15, and in fresh-water station 1. Except in the fresh-water pond, it was always collected along with many Atlantic silversides, Menidia menidia. Since the two species are very similar in appearance, it can be easily overlooked in collections and mistaken for Menidia menidia.

Menidia menidia (Linnaeus). Atlantic silverside. Figs. 24, 25.

The Atlantic silverside was by far the most abundant fish taken during this study. It was collected at one time or another at virtually every seine station in Chincoteague Bay proper. It was absent from some of the 8 regular seining stations only during the winter. During the coldest months, it probably moves into deeper water within the bay and there may be some movement to deep waters out of the bay. Spawning was taking place during the collections on 9-10 May 1970 and almost all the fish collected were adults. A length frequency histogram (Fig. 25) of specimens collected over a year's time suggests that the Atlantic silverside lives only one year in Chincoteague Bay, spawning once and then dying shortly thereafter. This is in agreement with studies made by Bayliff (1950) in the Patuxent River. In August 1969, the population showed two size classes, one with a modal length of about 50 mm, the other with a modal length of about 115 mm. By October 1969, the larger group appeared to be gone and the smaller size class now had a modal length of about 80 mm. In March 1970, the modal length still appeared to be about 80 mm. In May, when reproduction was taking place, the modal length had increased to about 95 mm. In June there were again two size classes, the smaller with a modal length of about 45 mm, the larger with a modal length of about 100 mm. Schwartz (1961) stated that the Atlantic silverside is absent in the bay from June to October. In the present study, however, it was taken in greatest abundance during this period. The discrepancy is probably due to the differences in collecting gear and localities. Schwartz relied primarily on trawling while in this study the emphasis was on beach seining. During the present study no Menidia were collected in trawls.

BOTHIDAE -- Lefteye flounders.

Paralichthys dentatus (Linnaeus). Summer flounder. Fig. 26.

Only two summer flounders were taken in the course of this study, one in late June at seine station 6 and another in July at station 14.

PLEURONECTIDAE -- Righteye flounders.

Pseudopleuronectes americanus (Walbaum). Winter flounder. Fig. 27.

Winter flounder were relatively abundant at some stations in Chincoteague Bay and were collected at seine stations 1, 2, 4-7, 10, and 11. The largest collection was made in June at station 2 when 16 young were collected. Larger fish were taken with a 10-foot trawl at stations 10 and 11 in March. It would appear that the shallow areas of eastern Chincoteague Bay form a nursery area for winter flounder.

SOLEIDAE -- Soles.

Trinectes maculatus (Bloch and Schneider). Hogchoker. Fig. 28.

Hogchokers were taken in deeper waters of the bay during the fall at trawl stations 1, 2, and 4.

TETRAODONTIDAE -- Puffers.

Sphoeroides maculatus (Bloch and Schneider). Northern puffer. Fig. 29.

The northern puffer is common and widely distributed in Chincoteague Bay. It was taken at seine stations 1-4, 6-8, and at trawl stations 1 and 4.

DIODONTIDAE -- Porcupinefishes.

Chilomycterus schoepfi (Walbaum). Striped burrfish. Fig. 31.

The striped burrfish was collected at two stations in August 1969. One was taken at seine station 4 and three at station 8.

BATRACHOIDIDAE -- Toadfishes.

Opsanus tau (Linnaeus). Oyster toadfish. Fig. 30.

The oyster toadfish was taken at seine stations 1, 2, 4-8, and 15 and at trawl stations 1-3.

RESULTS AND DISCUSSION

The species and numbers of fishes that were preserved at regular seine stations 1 through 8 are listed in Tables 2-9, those collected at miscellaneous seine stations 9 through 16 are listed in Table 10, those taken by 25-foot otter trawl are listed in Table 11, and those from the fresh-water ponds are listed in Table 12. A total of 40 species were taken from the waters of Chincoteague Bay proper. Six of these, Conger oceanicus, Hyporhamphus sp. Caranx hippos, Trachinotus falcatus, Microgobius thalassinus, and Membras martinica, had not been previously reported from Chincoteague Bay. Only Conger oceanicus and Trinectes maculatus were not represented by at least one specimen from the shallows of the eastern part of Chincoteague Bay.

The shallow, vegetated areas in the eastern part of the bay are especially productive spawning and/or nursery areas for many species of fishes. The silversides and anchovies are particularly abundant throughout the shallow portions of the bay and these fishes form an important food for many other species of fish. Cyprinodon variegatus, Fundulus heteroclitus, Fundulus majalis, and Lucania parva are all dependent upon relatively shallow protected waters and the sticklebacks and northern pipefish seem to be more abundant there also. The young of many other species were also regularly taken at these same stations, including menhaden, silver perch, spot, white mullet, winter flounder, and toadfish. Young silver perch were particularly abundant at some stations during the summer.

Collections made in salt marsh ponds often reveal them to be inhabited by large populations of Cyprinodon variegatus with Fundulus heteroclitus also being abundant. In May, two such ponds also had large populations of young-of-the-year threespine sticklebacks. Only one species, Fundulus diaphanus, of the five species of fishes collected in fresh-water ponds on Assateague Island, was not also taken very commonly in the saline waters of the bay. Fundulus diaphanus

is a fresh-water fish that is commonly taken in the lower saline portions of estuaries and is probably common in many of the tributary creeks of Chincoteague Bay. Besides the five species of fishes (Table 12) that were collected from the fresh-water ponds, there were numerous aquatic insects and three of the ponds had many tadpoles in them.

Trawl collections from three borrow pits in Isle of Wight Bay contained a total of 17 species of fish (Table 13), all of which have been listed at least once from Chincoteague Bay (Schwartz, 1961). However, an American sand lance, Ammodytes americanus DeKay, was collected in a benthic sample with a Petersen dredge. The American sand lance has not previously been reported from either Isle of Wight or Chincoteague Bays. While several of the species taken from the borrow pits in Isle of Wight Bay are not common in Chincoteague Bay, their presence in these pits suggests that similar areas, if created in Chincoteague Bay, would be inhabited by fishes that are commonly found in the deeper waters of Chincoteague Bay.

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Table 1. Location of sampling stations in Chincoteague Bay.

Regular seining stations:

1. Lone Pond about 1 1/2 miles NNE of Green Run Bay.
2. North shore of Great Egging Beach, just south of Sinepuxent Bay.
3. At small island just south of Little Egging Beach.
4. One-half mile west of Tingles Island and 1/2 mile south of Outward Tump.
5. South side of Rum Harbor Cove.
6. Mouth of Terrapin Creek in Pope Island Ditch.
7. Northern edge of Chincoteague National Wildlife Refuge between Bay Point and Bay Island.
8. Just north of Sugar Point.

Miscellaneous seining stations:

9. Channel between Pope Bay and Pope Island Ditch.
10. Mouth of Tanhouse Creek, and trawl parallel to shore with 10-foot otter trawl.
11. Beach just below Scarboro Creek, and trawl perpendicular to shore to 1/4 mile offshore.
12. Northwest corner of Pope Bay.
13. Just inside south exit channel of Pope Bay.
14. Southeast corner of Pope Bay.
15. Just inside south exit channel of Pitt's Island Bay.
16. Southeast corner of Pitt's Island Bay.

Fresh-water seining stations:

1. 3250 yds. 130° from Light #31.
2. 4500 yds. 170° from tip of Sugar Point.
3. Three connected ponds just north of Fox Hill Levels.
4. Pond inland and about 0.85 mi. south of Lone Pond Gut.

Trawl stations:Otter trawl:

1. Between Kelly Point and Light #39.
2. One mile east of Robin's Marsh.
3. 2200 yds. north of Wittington Point.
4. One mile east of Martin Bay.
5. In dredged channel east of south point from Beacon #31 north.

Beam trawl:

6. Between Robin's Marsh and Light #39.
7. Kelly Point to 1/4 mile offshore due east.
8. Parallel to shore from Kelly Point to Rick's Point.

Table 2. Species and number of fishes collected at regular seine station number 1 in Chincoteague Bay.

Species	August 4-6, 1969	March 9-10, 1970	May 9-10, 1970	June 23-24, 1970
<u>Rhinoptera bonasus</u>				1
<u>Brevoortia tyrannus</u>	36			4
<u>Anchoa mitchilli</u>	44		2	9
<u>Anguilla rostrata</u>	9			1
<u>Strongylura marina</u>	2			2
<u>Fundulus heteroclitus</u>	38			
<u>Fundulus majalis</u>	30			
<u>Lucania parva</u>	4			
<u>Apeltes quadracus</u>	19			4
<u>Gasterosteus aculeatus</u>		1		
<u>Syngnathus fuscus</u>	15			9
<u>Pomatomus saltatrix</u>	2			1
<u>Caranx hippos</u>				1
<u>Bairdiella chrysura</u>	82			2
<u>Cynoscion regalis</u>	1			
<u>Leiostomus xanthurus</u>	1			
<u>Gobiosoma boscii</u>				1
<u>Chasmodes bosquianus</u>	1			
<u>Mugil cephalus</u>	4			
<u>Membras martinica</u>			1	
<u>Menidia beryllina</u>				1
<u>Menidia menidia</u>	377		7	27
<u>Pseudopleuronectes americanus</u>				4
<u>Sphoeroides maculatus</u>			2	1
<u>Opsanus tau</u>	9			

Table 3. Species and number of fishes collected at regular seine station number 2 in Chincoteague Bay.

Species	August 4-6, 1969	October 20-21, 1969	March 9-10, 1970	May 9-10, 1970	June 23-24, 1970
<u>Anchoa mitchilli</u>	34	39			1
<u>Anguilla rostrata</u>					1
<u>Strongylura marina</u>	9			2	5
<u>Hyporhamphus</u> sp.				1	
<u>Fundulus heteroclitus</u>	1				
<u>Apeltes quadracus</u>	3				1
<u>Syngnathus fuscus</u>	2	1		2	4
<u>Bairdiella chrysura</u>	3	4			
<u>Mugil curema</u>		2			
<u>Membras martinica</u>	2			4	1
<u>Menidia beryllina</u>		2			
<u>Menidia menidia</u>	26	95	2	39	70
<u>Pseudopleuronectes americanus</u>	11			2	16
<u>Sphoeroides maculatus</u>	1			1	
<u>Opsanus tau</u>	4	1			

Table 4. Species and number of fishes collected at regular
seine station number 3 in Chincoteague Bay

Species	August 4-6, 1969	October 20-21, 1969	May 9-10, 1970	June 23-24, 1970
<u>Anchoa mitchilli</u>				1
<u>Anguilla rostrata</u>				1
<u>Strongylura marina</u>	12			1
<u>Cyprinodon variegatus</u>	14	7		3
<u>Fundulus heteroclitus</u>	16	5	6	51
<u>Fundulus majalis</u>	52	43		9
<u>Lucania parva</u>	1			
<u>Apeltes quadracus</u>				11
<u>Trachinotus falcatus</u>	1			
<u>Leiostomus xanthurus</u>				1
<u>Mugil curema</u>				15
<u>Menidia beryllina</u>		70	1	1
<u>Menidia menidia</u>	70	134	59	125
<u>Sphoeroides maculatus</u>				1

Table 5. Species and number of fishes collected at regular
seine station number 4 in Chincoteague Bay.

Species	August 4-6, 1969	October 20-21, 1969	March 9-10, 1970	May 9-10, 1970	June 23-24, 1970
<u>Dasyatis americana</u>	1				1
<u>Anchoa mitchilli</u>	11	20			
<u>Anguilla rostrata</u>	1				
<u>Lucania parva</u>	13				
<u>Apeltes quadracus</u>	7				
<u>Gasterosteus aculeatus</u>				1	
<u>Syngnathus fuscus</u>	15	1		1	2
<u>Membras martinica</u>	2			9	3
<u>Menidia menidia</u>	17	6		69	28
<u>Pseudopleuronectes americanus</u>	2				2
<u>Sphoeroides maculatus</u>					2
<u>Chilomycterus schoepfi</u>	1				
<u>Opsanus tau</u>	2				

Nothing Caught

Table 6. Species and number of fishes collected at regular seine station number 5 in Chincoteague Bay.

Species	August 4-6, 1969	October 20-21, 1969	March 9-10, 1970	May 9-10, 1970	June 23-24, 1970
<u>Brevoortia tyrannus</u>	7				45
<u>Clupea harengus</u>				1	
<u>Anchoa mitchilli</u>	20	20		28	114
<u>Anguilla rostrata</u>			1		
<u>Cyprinodon variegatus</u>		37		17	
<u>Fundulus heteroclitus</u>		10		13	1
<u>Fundulus majalis</u>		2			
<u>Lucania parva</u>		1		14	
<u>Gasterosteus aculeatus</u>				56	
<u>Syngnathus fuscus</u>	4	2			1
<u>Pomatomus saltatrix</u>					1
<u>Bairdiella chrysura</u>	18	5			
<u>Microgobius thalassinus</u>			1		
<u>Membras martinica</u>				3	
<u>Menidia beryllina</u>		4			
<u>Menidia menidia</u>	20	10		4	99
<u>Pseudopleuronectes americanus</u>			1		1
<u>Opsanus tau</u>		1			

Table 7. Species and number of fishes collected at regular
seine station number 6 in Chincoteague Bay.

Species	August 4-6, 1969	October 20-21, 1969	March 9-10, 1970	May 9-10, 1970	June 23-24, 1970
<u>Anchoa mitchilli</u>	19	22			29
<u>Anguilla rostrata</u>	3		1		4
<u>Cyprinodon variegatus</u>		25			
<u>Fundulus heteroclitus</u>	4	24		2	8
<u>Lucania parva</u>	1				
<u>Apeltes quadracus</u>	10			2	10
<u>Syngnathus fuscus</u>	16			5	7
<u>Bairdiella chrysura</u>	10	2			
<u>Leiostomus xanthurus</u>	1				
<u>Microgobius thalassinus</u>		1		1	
<u>Gobiosoma bosci</u>			1		
<u>Mugil cephalus</u>	4				
<u>Menidia beryllina</u>				1	
<u>Menidia menidia</u>	46	30		62	34
<u>Paralichthys dentatus</u>					1
<u>Pseudopleuronectes americanus</u>					1
<u>Sphoeroides maculatus</u>	1			2	
<u>Opsanus tau</u>	5	3		1	4

Table 8. Species and number of fishes collected at regular seine station number 7 in Chincoteague Bay.

Species	August 4-6, 1969	October 20-21, 1969	March 9-10, 1970	May 9-10, 1970	June 23-24, 1970
<u>Brevoortia tyrannus</u>					18
<u>Anchoa mitchilli</u>	8	48		43	8
<u>Anguilla rostrata</u>					1
<u>Strongylura marina</u>	2				4
<u>Cyprinodon variegatus</u>	14				1
<u>Fundulus heteroclitus</u>	8	5			12
<u>Lucania parva</u>					5
<u>Apeltes quadracus</u>	4			1	
<u>Syngnathus fuscus</u>		2			6
<u>Bairdiella chrysura</u>		9			
<u>Leiostomus xanthurus</u>	1	1			
<u>Membras martinica</u>				6	
<u>Menidia beryllina</u>				1	3
<u>Menidia menidia</u>	61	38	21	106	70
<u>Pseudopleuronectes americanus</u>					1
<u>Sphoeroides maculatus</u>	1				4
<u>Opsanus tau</u>	1	3			1

Table 9. Species and number of fishes collected at regular seine station number 8 in Chincoteague Bay.

Species	August 4-6, 1969	October 20-21, 1969	March 9-10, 1970	May 9-10, 1970	June 23-24, 1970
<u>Dasyatis americana</u>	1				1
<u>Brevoortia tyrannus</u>	2				
<u>Anchoa mitchilli</u>	1	1			2
<u>Anguilla rostrata</u>				2	
<u>Strongylura marina</u>					1
<u>Cyprinodon variegatus</u>				25	2
<u>Fundulus heteroclitus</u>			3	35	4
<u>Fundulus majalis</u>			1	1	5
<u>Apeltes quadracus</u>	4		1		
<u>Gasterosteus aculeatus</u>				8	
<u>Syngnathus fuscus</u>	4				
<u>Pomatomus saltatrix</u>					1
<u>Bairdiella chrysura</u>	6				
<u>Chasmodes bosquianus</u>	1				
<u>Menidia beryllina</u>			1	18	
<u>Menidia menidia</u>	39	36	40	47	59
<u>Sphoeroides maculatus</u>	2				
<u>Chilomycterus schoepfi</u>	3				
<u>Opsanus tau</u>	5				

Table 10. Species and number of fishes collected from
Chincoteague Bay at miscellaneous seine stations.

Species	S t a t i o n							
	9	10	11	12	13	14	15	16
<u>Dasyatis americana</u>			.			1		1
<u>Brevoortia tyrannus</u>						143	11	6
<u>Clupea harengus</u>			6					
<u>Anchoa mitchilli</u>	13			1		16	4	2
<u>Anguilla rostrata</u>		2					1	
<u>Strongylura marina</u>					1	1		3
<u>Cyprinodon variegatus</u>	1	1		9	273		1	1
<u>Fundulus heteroclitus</u>	17	1		33	429		33	23
<u>Fundulus majalis</u>	6							
<u>Syngnathus fuscus</u>	4						1	
<u>Morone americana</u>							1	
<u>Bairdiella chrysura</u>	2						1	1
<u>Microgobius thalassinus</u>		1						
<u>Mugil curema</u>					3		8	
<u>Menidia beryllina</u>				1	1	1	6	
<u>Menidia menidia</u>	77	5	1	123	65	17	37	6
<u>Paralichthys dentatus</u>						1		
<u>Pseudopleuronectes americanus</u>		1	1					
<u>Opsanus tau</u>	1						1	

Table 11. Species and number of fishes collected in Chincoteague
Bay by 25-ft. otter trawl.

Species	Trawl Station				
	1	2	3	4	5
<u>Anchoa mitchilli</u>	9	12	13	35	11
<u>Anguilla rostrata</u>	1				
<u>Conger conger</u>		1			
<u>Syngnathus fuscus</u>	4	4	2		
<u>Bairdiella chrysura</u>	3	5	8	4	6
<u>Cynoscion regalis</u>	1	2		1	7
<u>Leiostomus xanthurus</u>	2	3	2	3	2
<u>Microgobius thalassinus</u>	10				2
<u>Prionotus evolans</u>			1		
<u>Trinectes maculatus</u>	3	1		1	
<u>Sphoeroides maculatus</u>	1		2		2
<u>Opsanus tau</u>	1	1	1		2

Table 12. Species and number of fishes collected from
fresh-water ponds on Assateague Island

Species	S t a t i o n s				
	1		2	3	4
	23 June 1970	7 July 1970			
<u>Cyprinodon variegatus</u>			77		2
<u>Fundulus diaphanus</u>	24	71			24
<u>Fundulus heteroclitus</u>	2	1	14	2	
<u>Lucania parva</u>	4	49	2	25	9
<u>Menidia beryllina</u>	8	53			

Table 13. Species and number of fishes collected from borrow pits in Isle of Wight Bay.

Species	Locality 30 September 1969		
	Reedy Island end of 50th St.	Mallard Island End of 15th St.	Channel N. Buoy #6
<u>Anchoa hepsetus</u>		3	
<u>Anchoa mitchilli</u>	6	13	11
<u>Anguilla rostrata</u>			1
<u>Pomatomus saltatrix</u>	1		
<u>Bairdiella cysura</u>		2	3
<u>Cynoscion regalis</u>	7		5
<u>Leiostomus xanthurus</u>	7	1	3
<u>Prionotus carolinus</u>		1	
<u>Prionotus evolans</u>	1		
<u>Menidia menidia</u>	1		
<u>Etropus microstomus</u>		2	
<u>Paralichthys dentatus</u>		1	2
<u>Scophthalmus aquosus</u>		2	
<u>Pseudopleuronectes americanus</u>	6	1	1
<u>Trinectes maculatus</u>	2		
<u>Sphoeroides maculatus</u>		1	1
<u>Opsanus tau</u>			1
<u>June 1970</u>			
<u>Ammodytes americanus</u>		1	

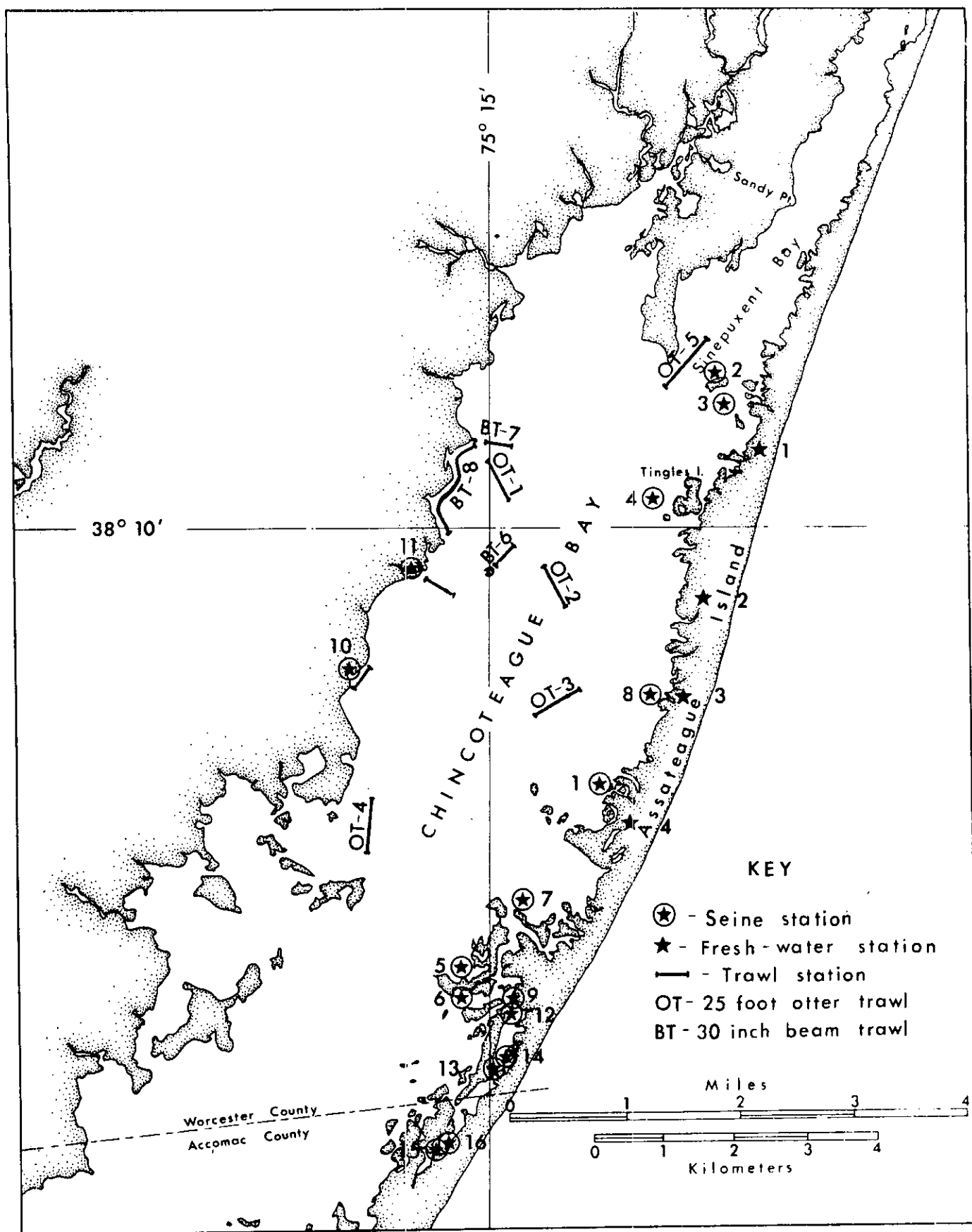


Fig. 1. Localities of collecting stations in Chincoteague Bay and on Assateague Island.

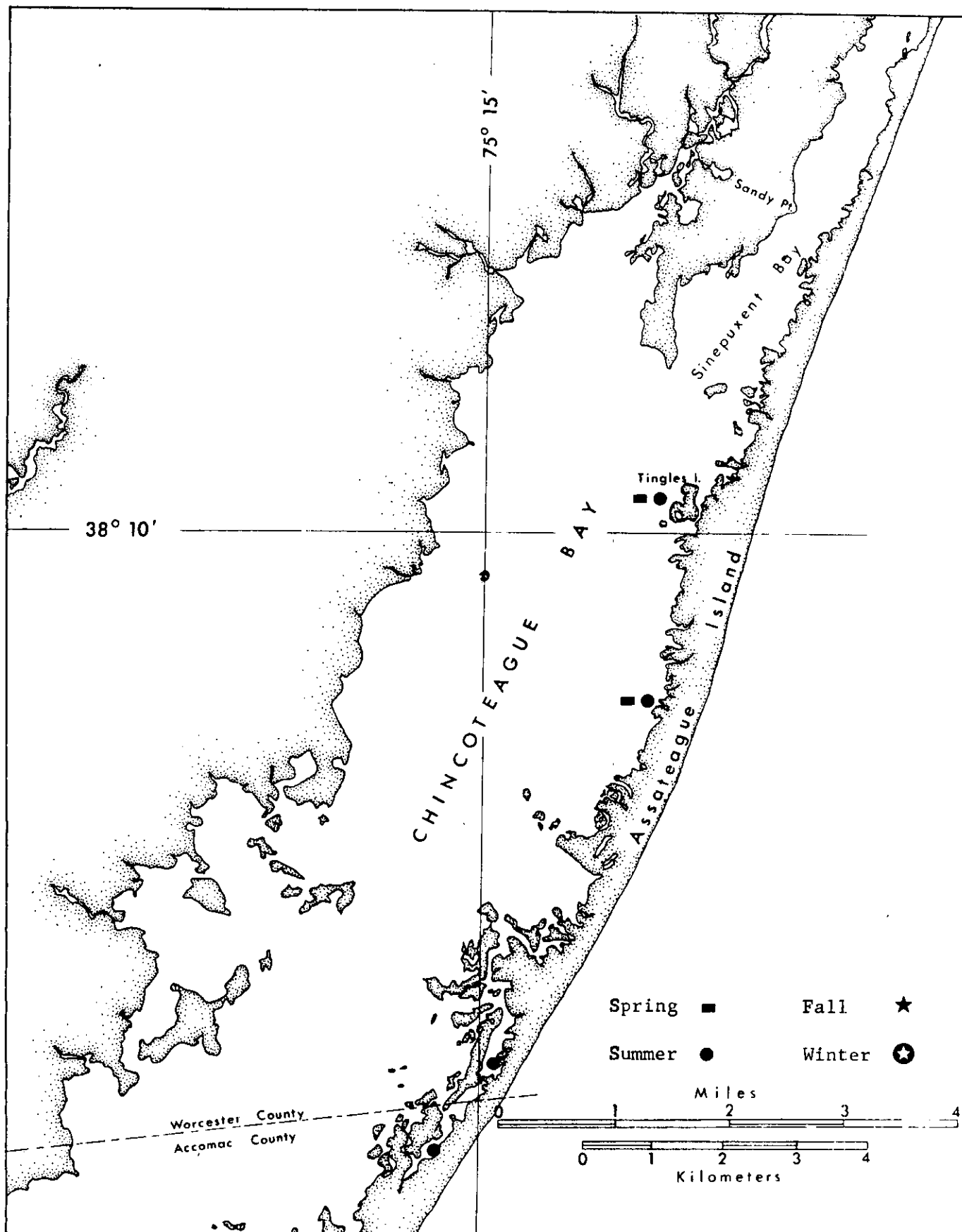


Fig. 2. Localities and season in which southern stingray, *Dasyatis americana*, was collected in Chincoteague Bay.

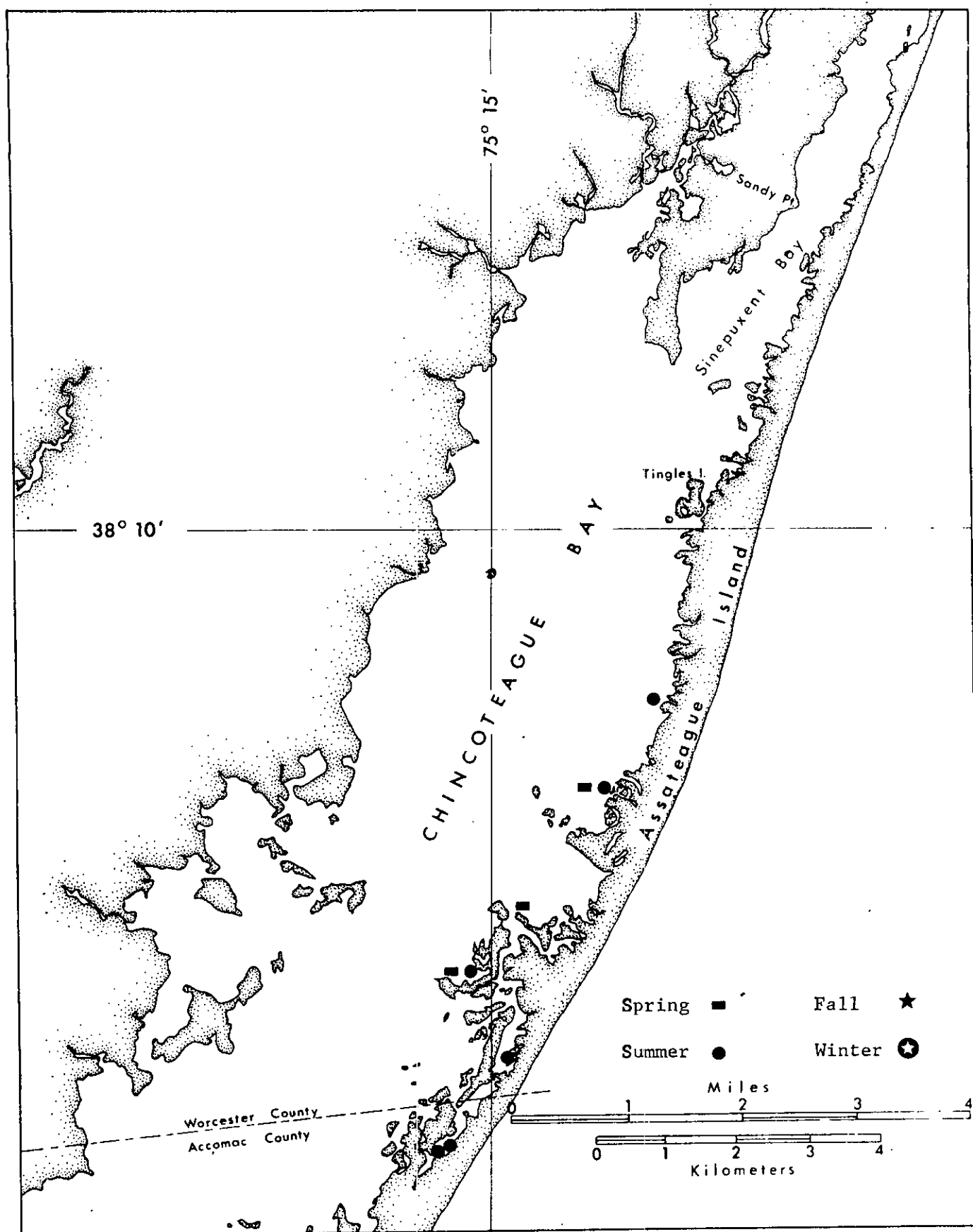


Fig. 3. Localities and season in which Atlantic menhaden, Brevoortia tyrannus, was collected in Chincoteague Bay.

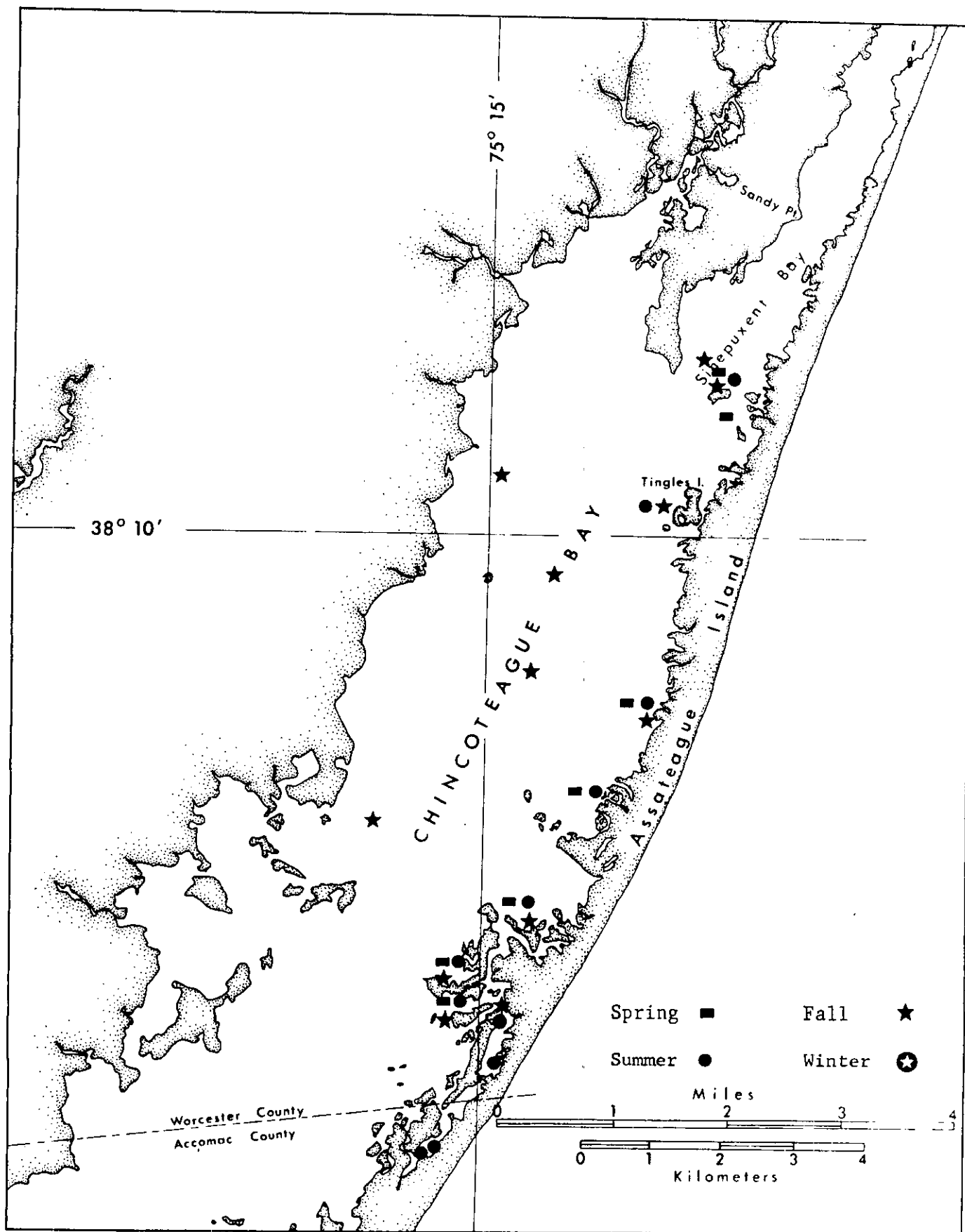


Fig. 4. Localities and season in which bay anchovy, *Anchoa mitchilli*, was collected in Chincoteague Bay.

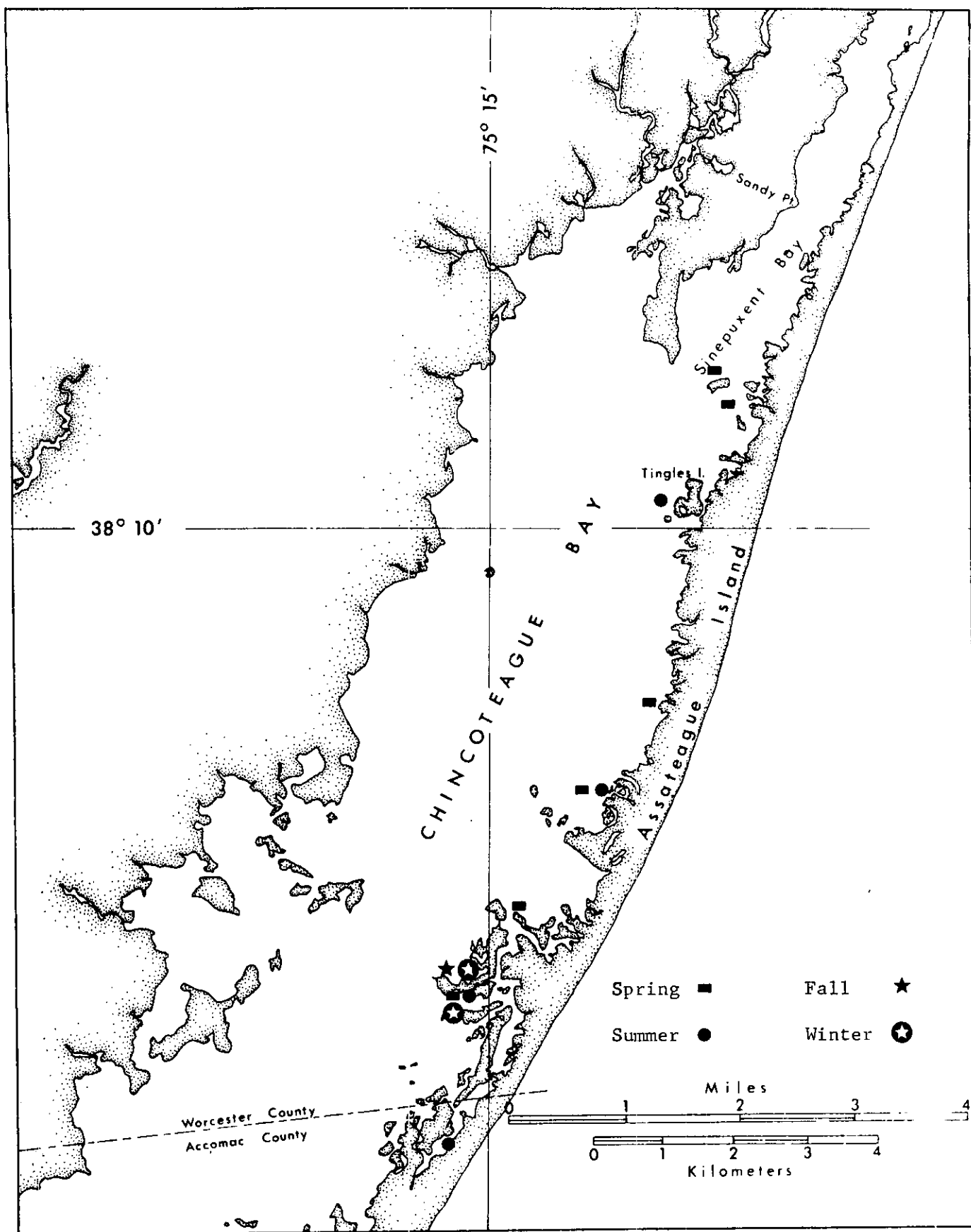


Fig. 5. Localities and season in which American eel, Anguilla rostrata, was collected in Chincoteague Bay.

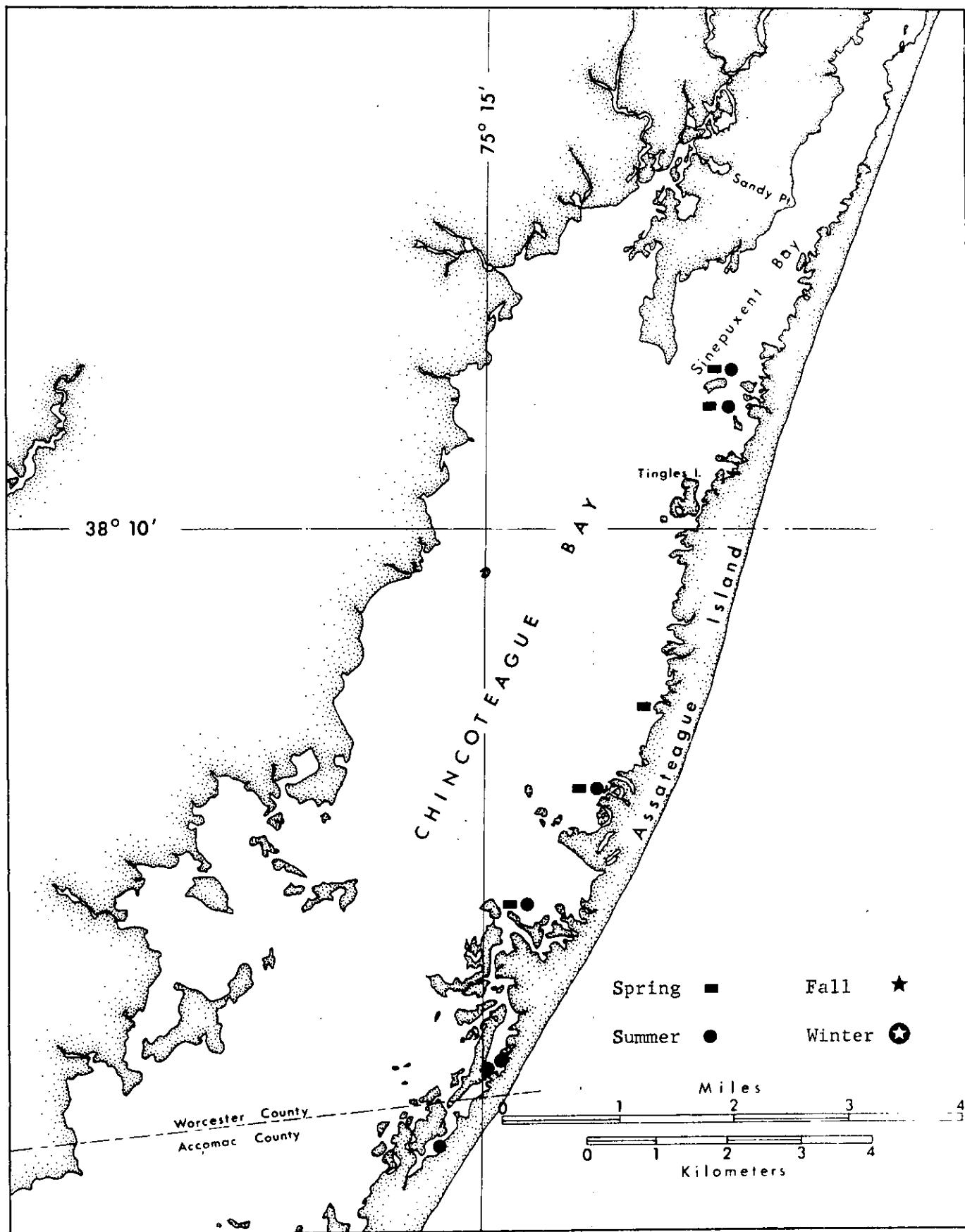


Fig. 6. Localities and season in which Atlantic needlefish, Strongylura marina, was collected in Chincoteague Bay.

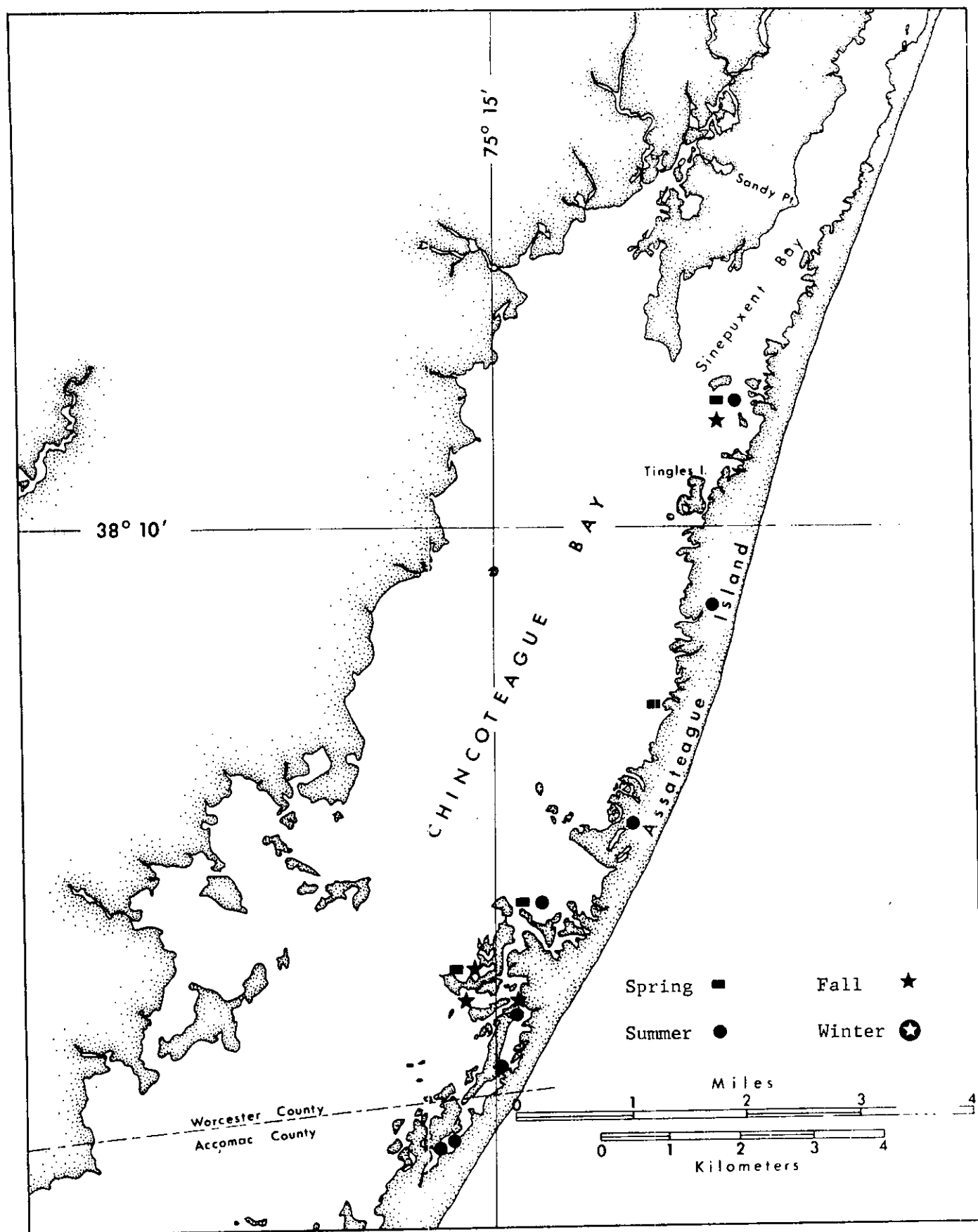


Fig. 7. Localities and season in which sheepshead minnow, *Cyprinodon variegatus*, was collected in Chincoteague Bay.

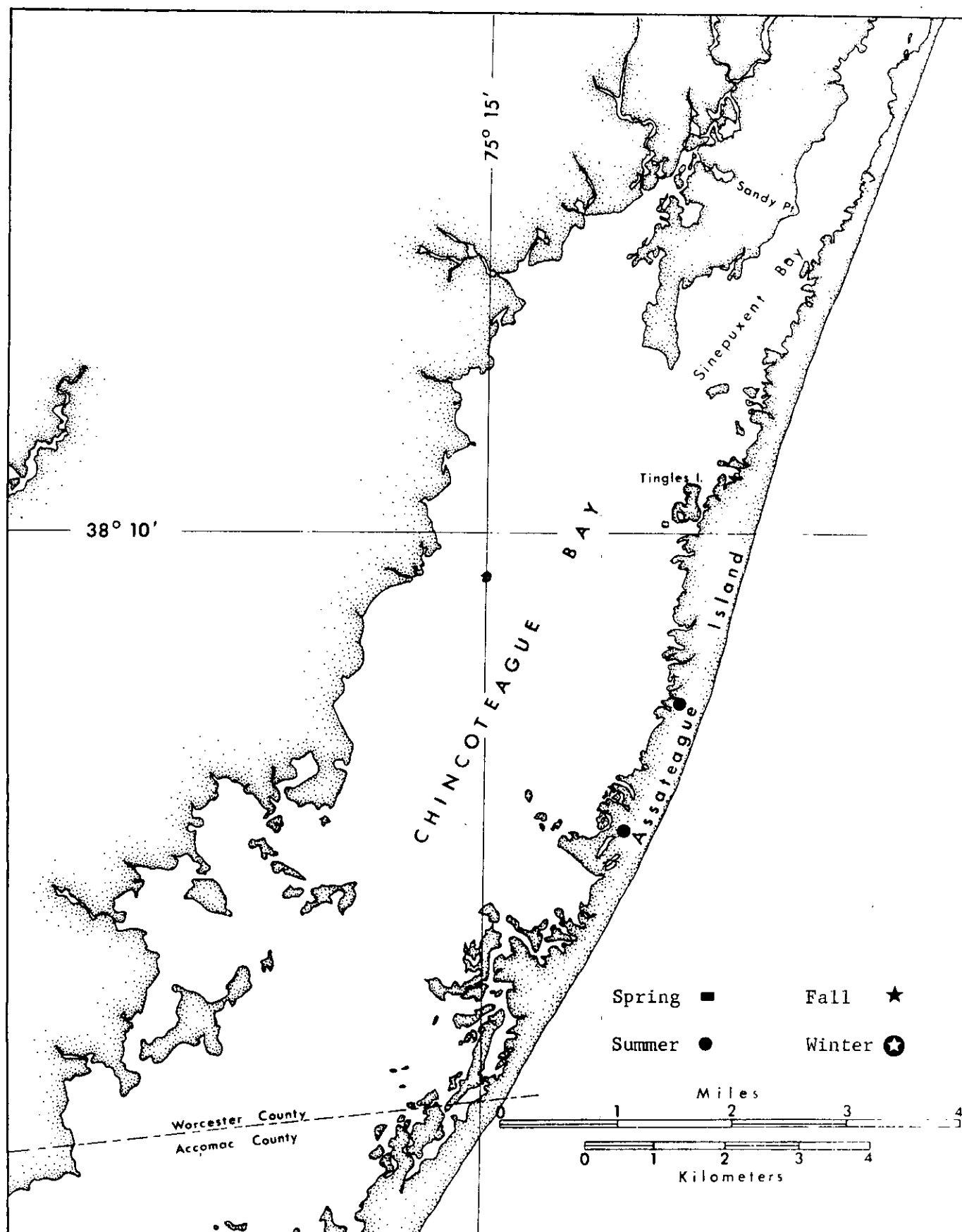


Fig. 8. Localities and season in which banded killifish, *Fundulus diaphanus*, was collected in Chincoteague Bay.

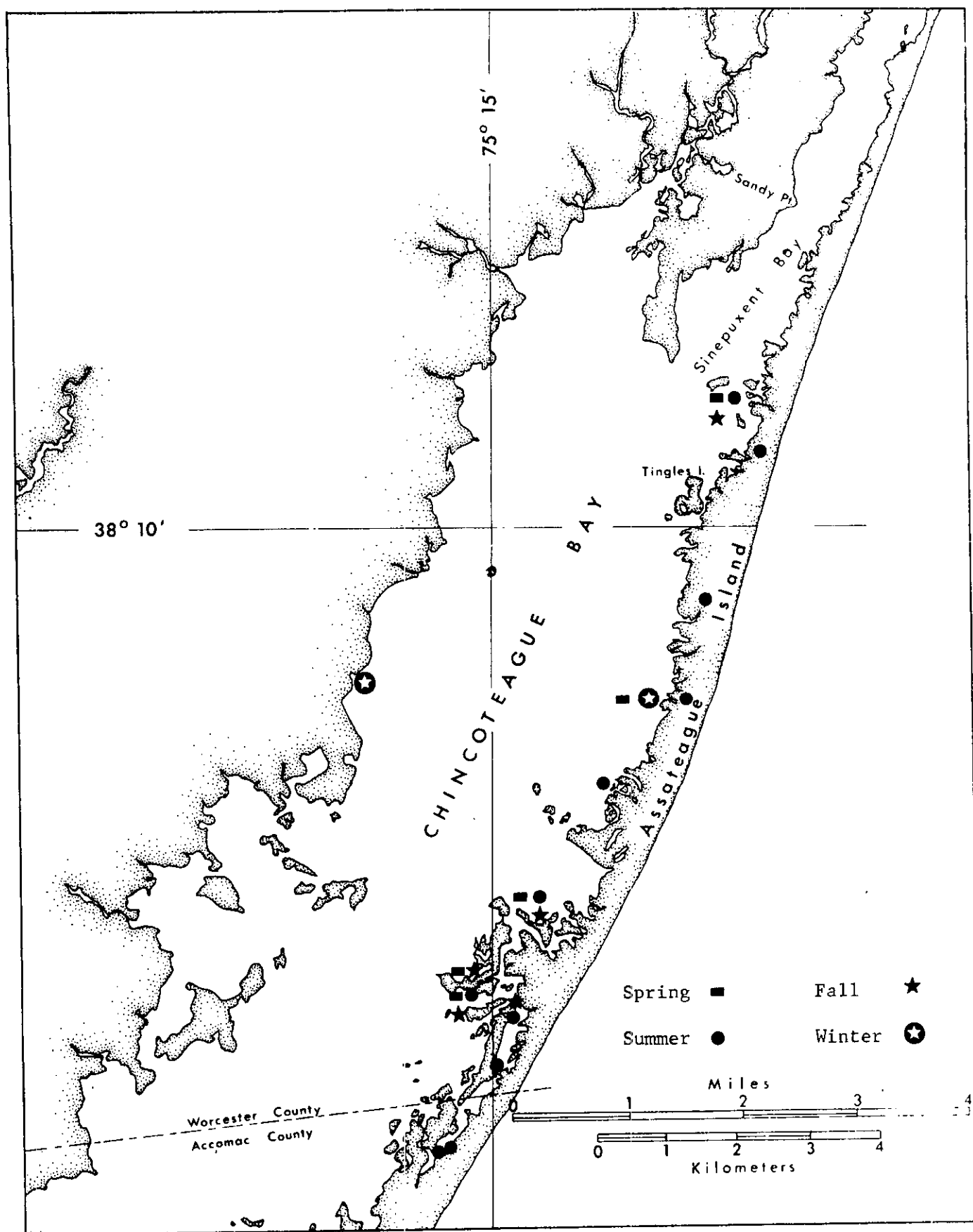


Fig. 9. Localities and season in which mummichog, *Fundulus heteroclitus*, was collected in Chincoteague Bay.

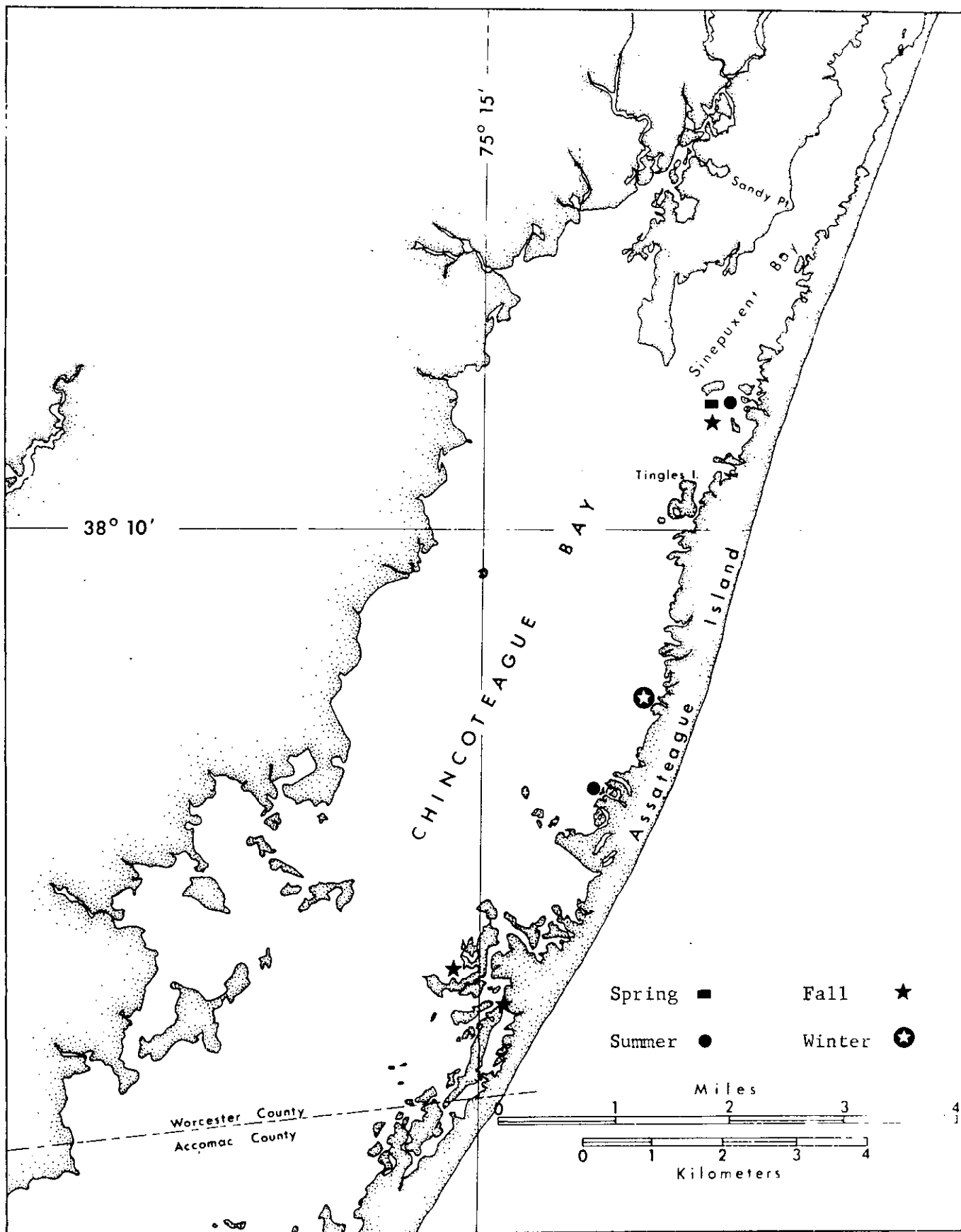


Fig. 10. Localities and season in which striped killifish, *Fundulus majalis*, was collected in Chincoteague Bay.

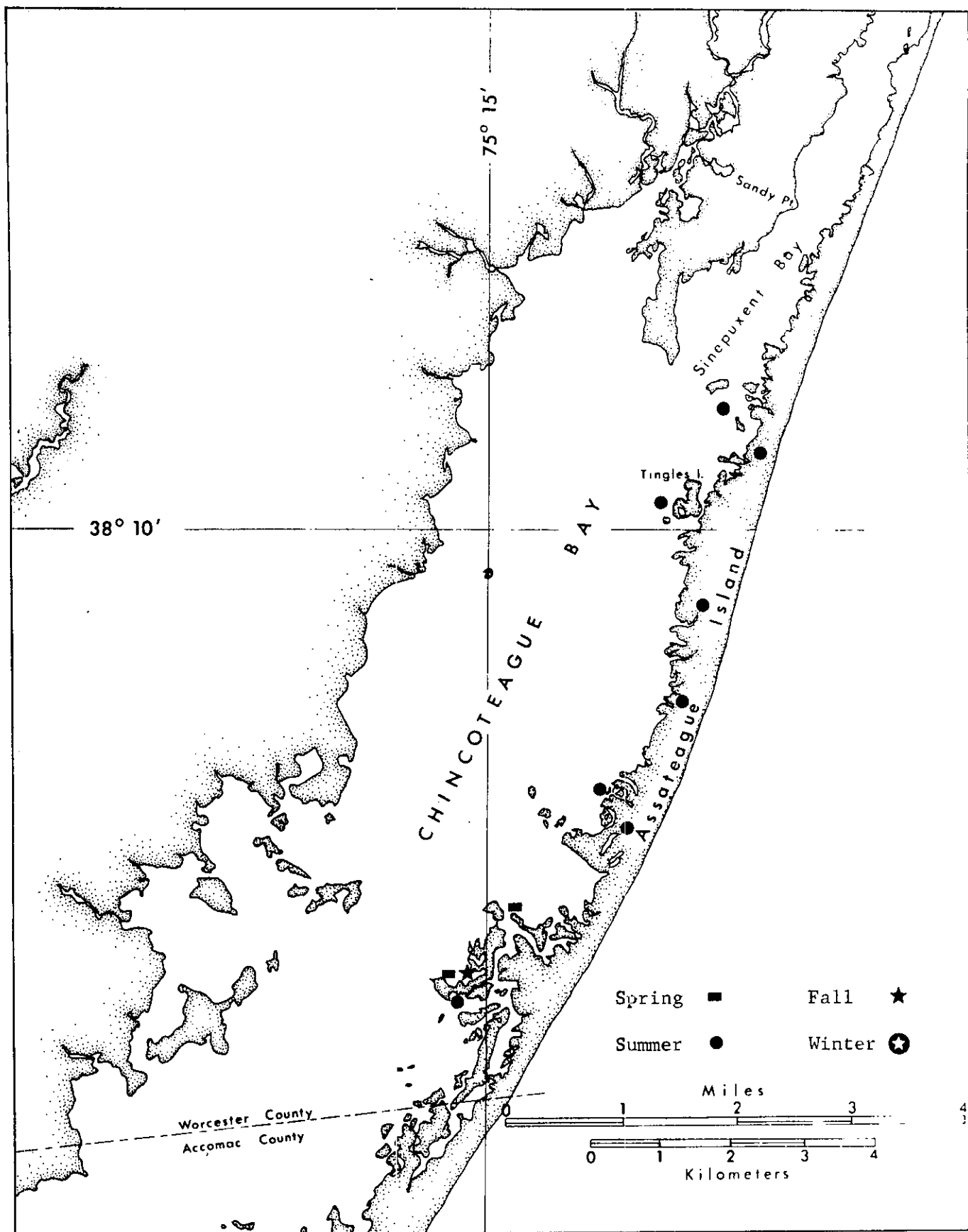


Fig. 11. Localities and season in which rainwater killifish, *Lucania parva*, was collected in Chincoteague Bay.

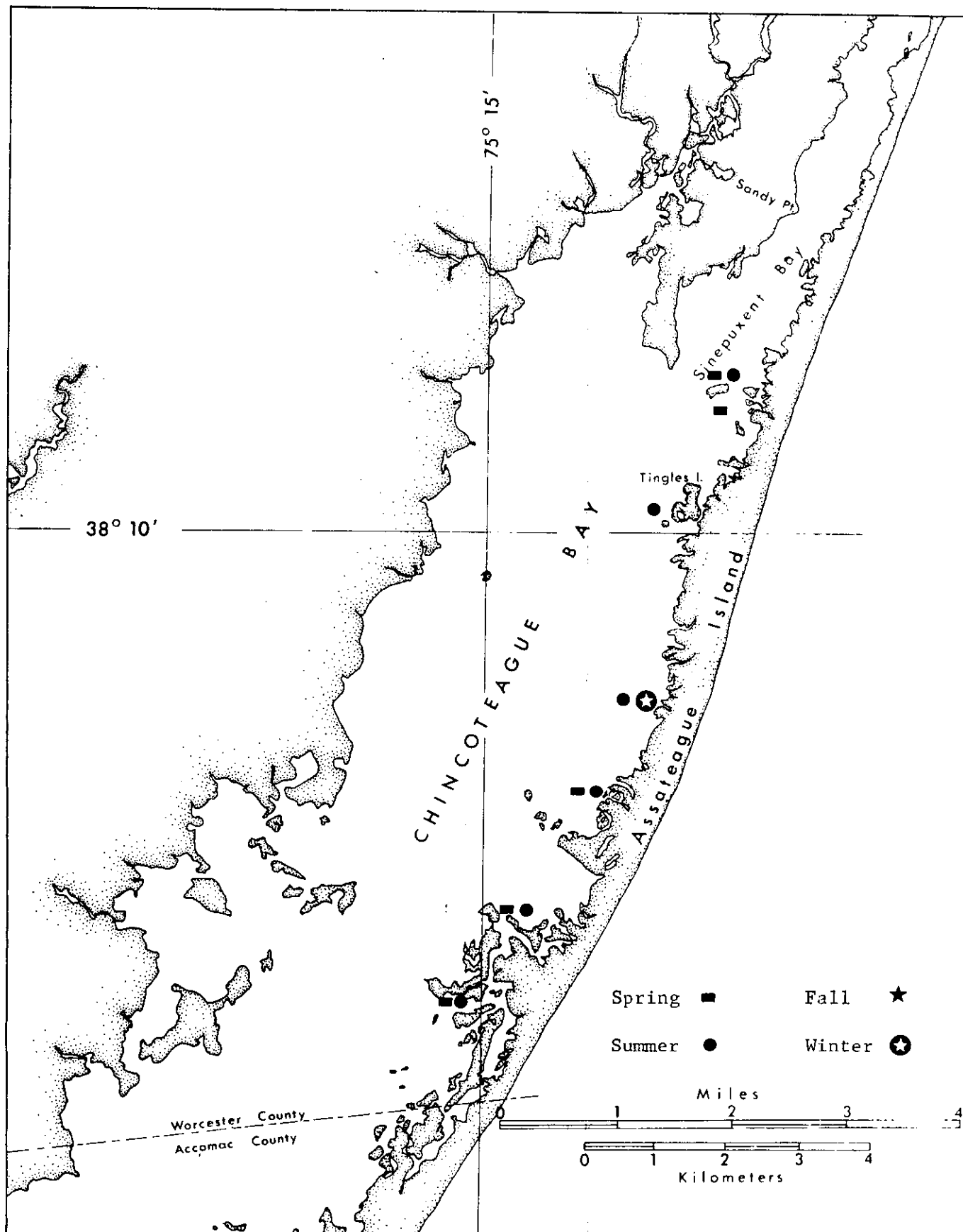


Fig. 12. Localities and season in which fourspine stickleback, Apeltes quadracus, was collected in Chincoteague Bay.

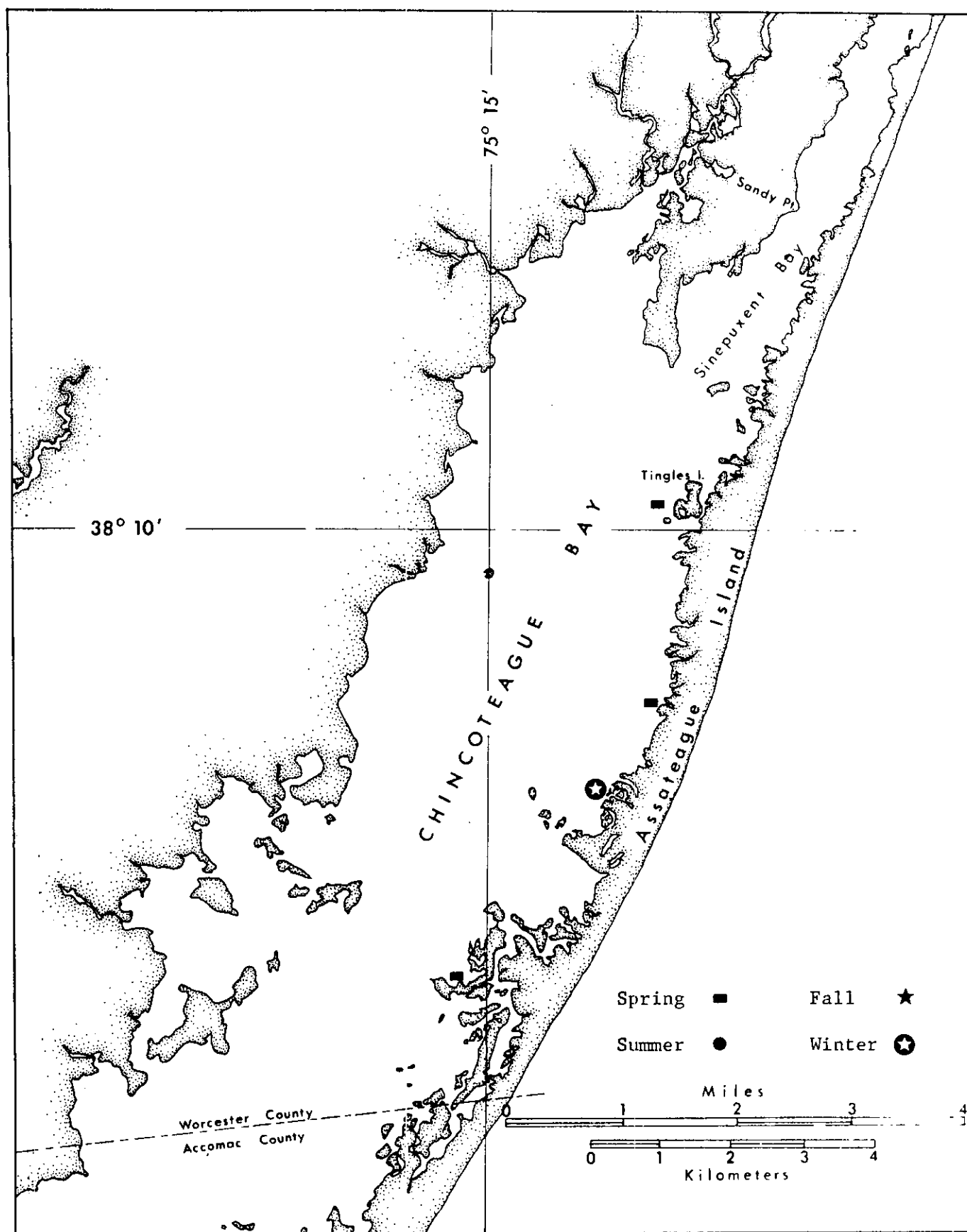


Fig. 13. Localities and season in which threespine stickleback, Gasterosteus aculeatus, was collected in Chincoteague Bay.

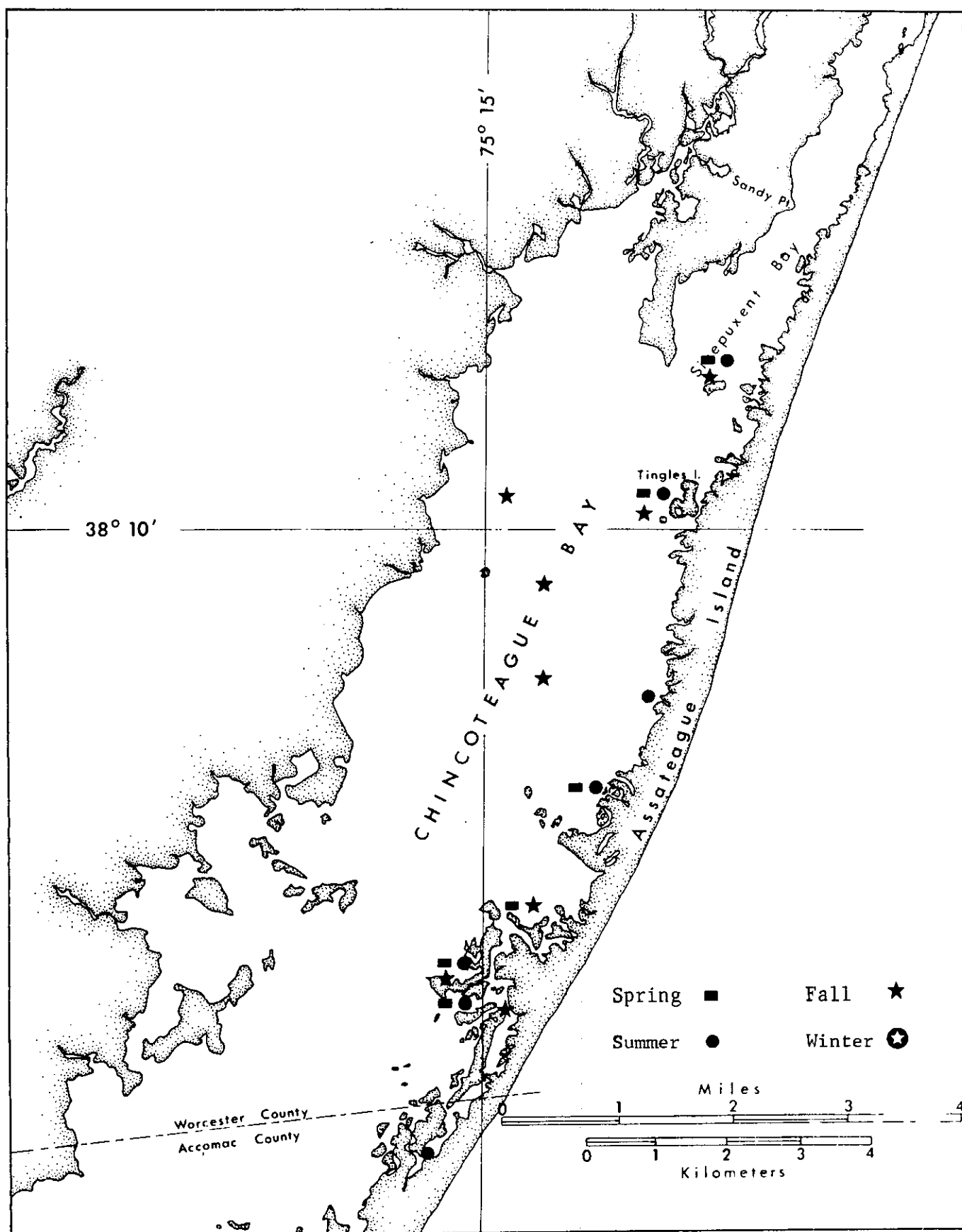


Fig. 14. Localities and season in which northern pipefish, *Syngnathus fuscus*, was collected in Chincoteague Bay.

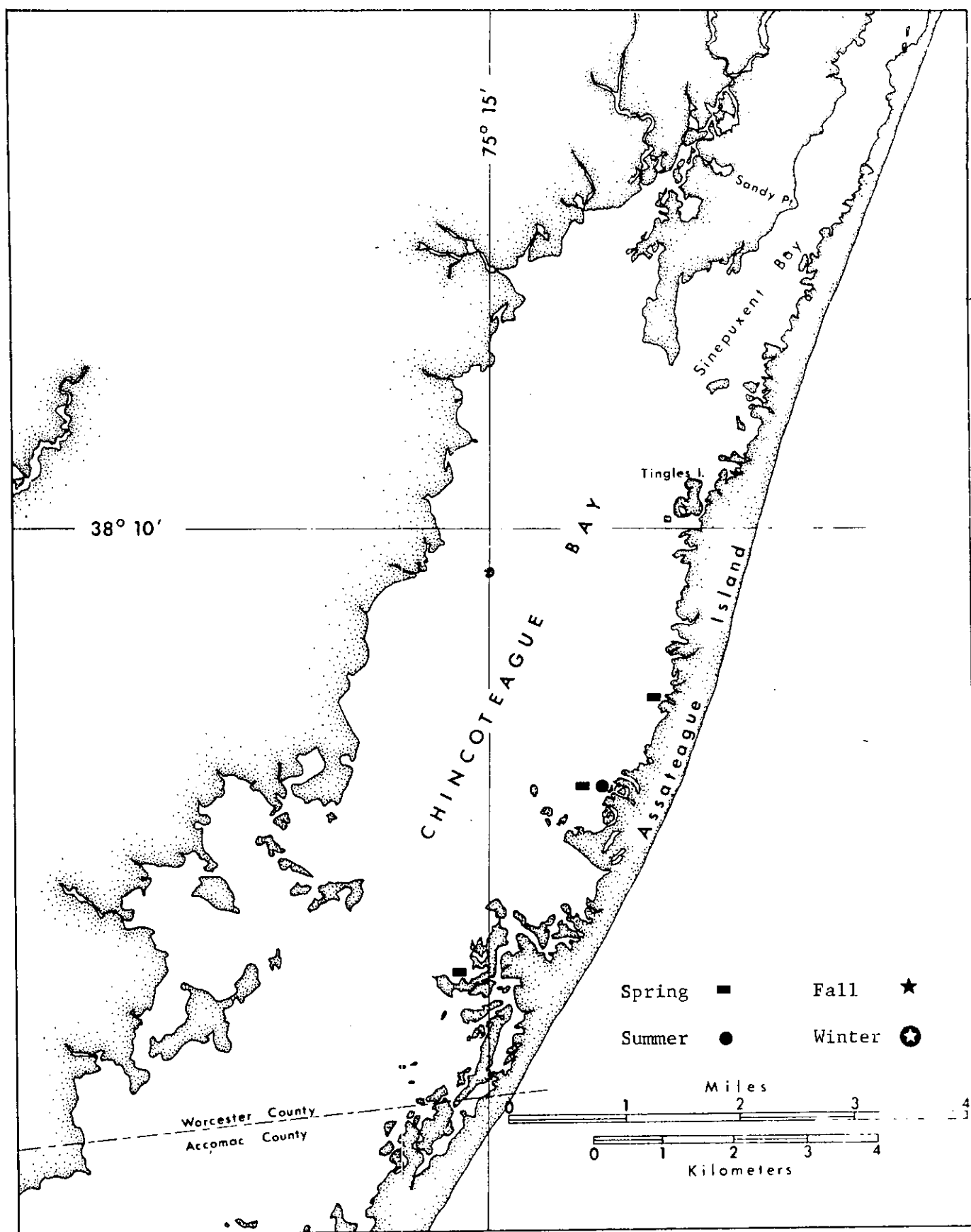


Fig. 15. Localities and season in which bluefish, Pomatomus saltatrix, was collected in Chincoteague Bay.

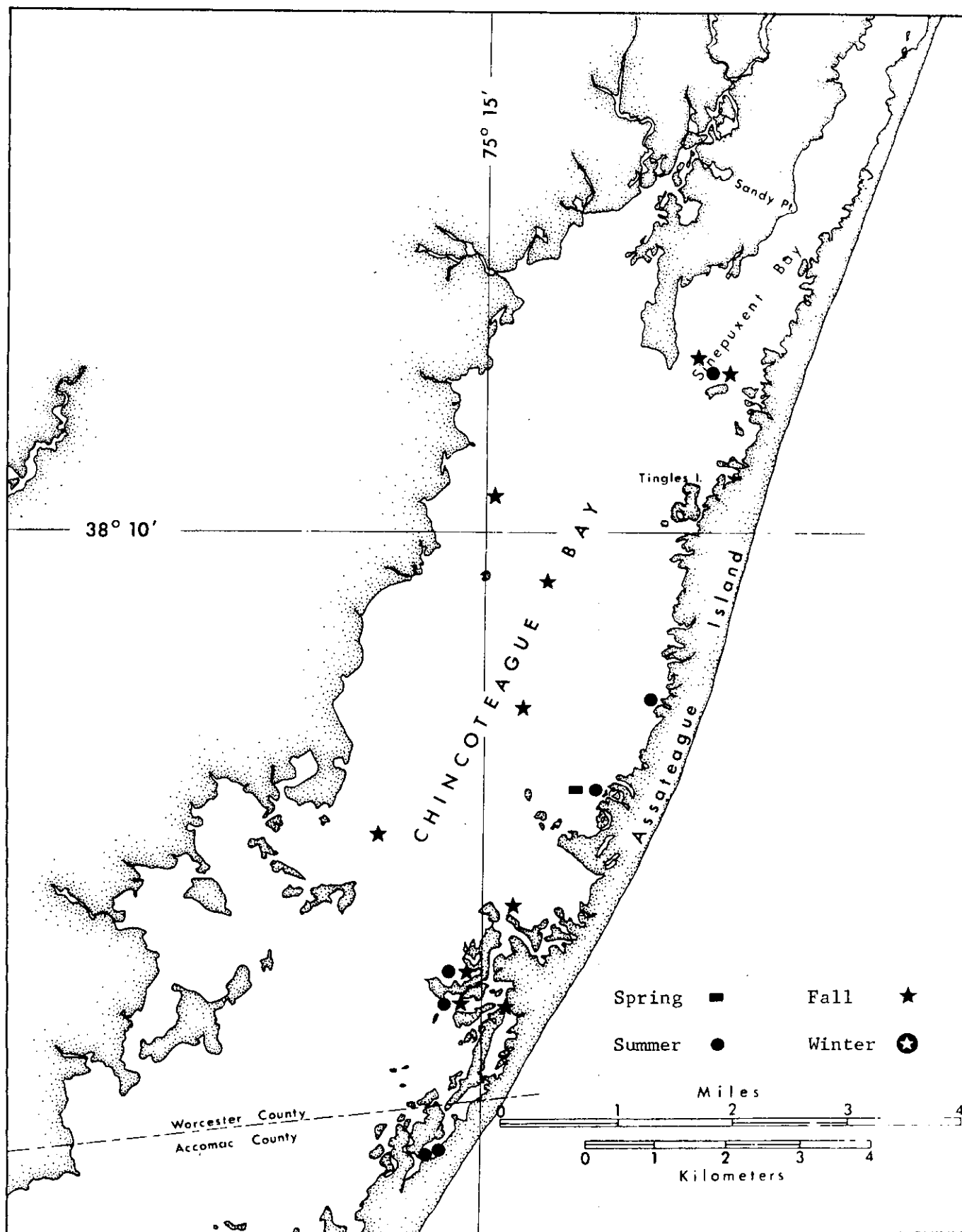


Fig. 16. Localities and season in which silver perch, Bairdiella chrysura, was collected in Chincoteague Bay.

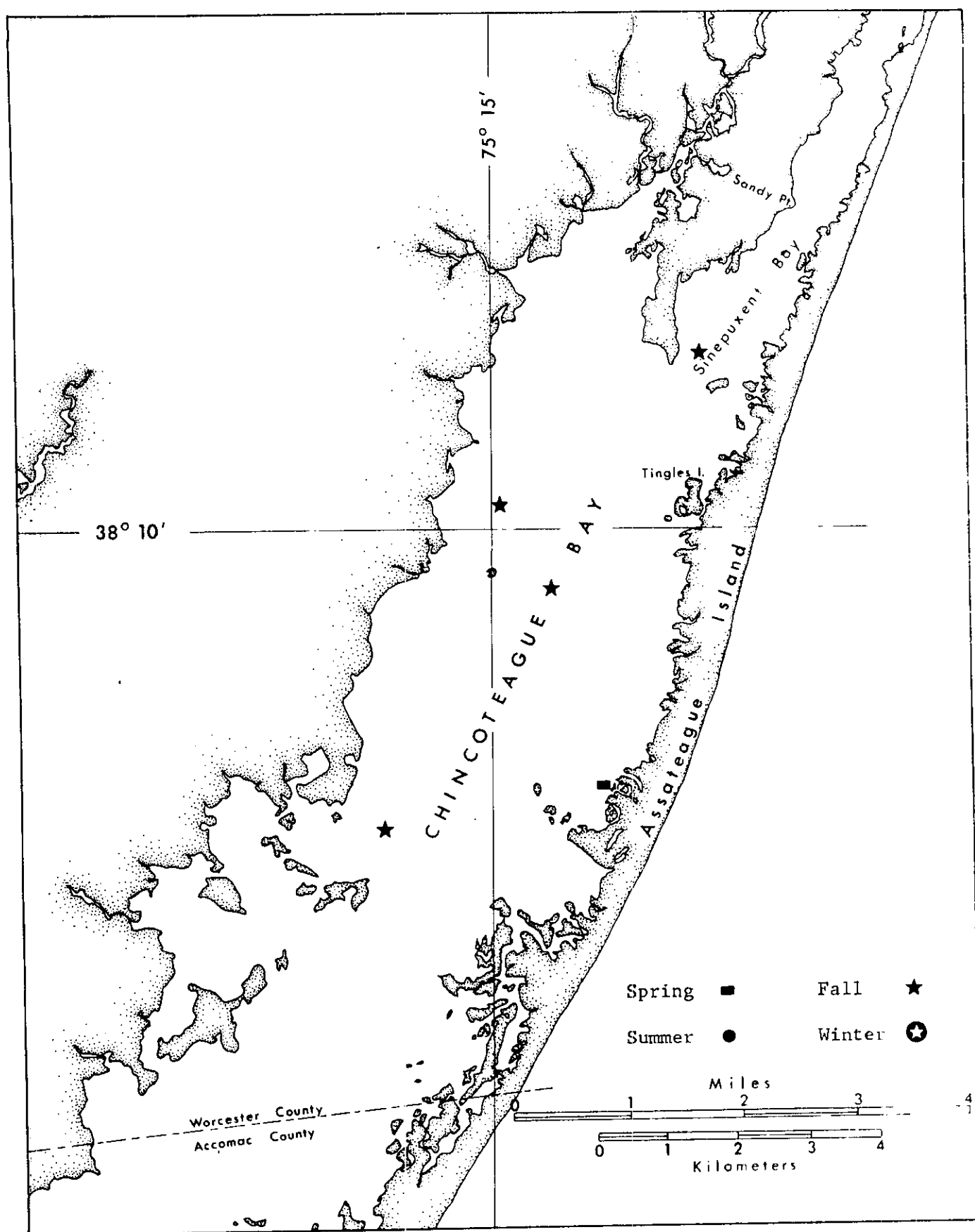


Fig. 17. Localities and season in which weakfish, *Cynoscion regalis*, was collected in Chincoteague Bay.

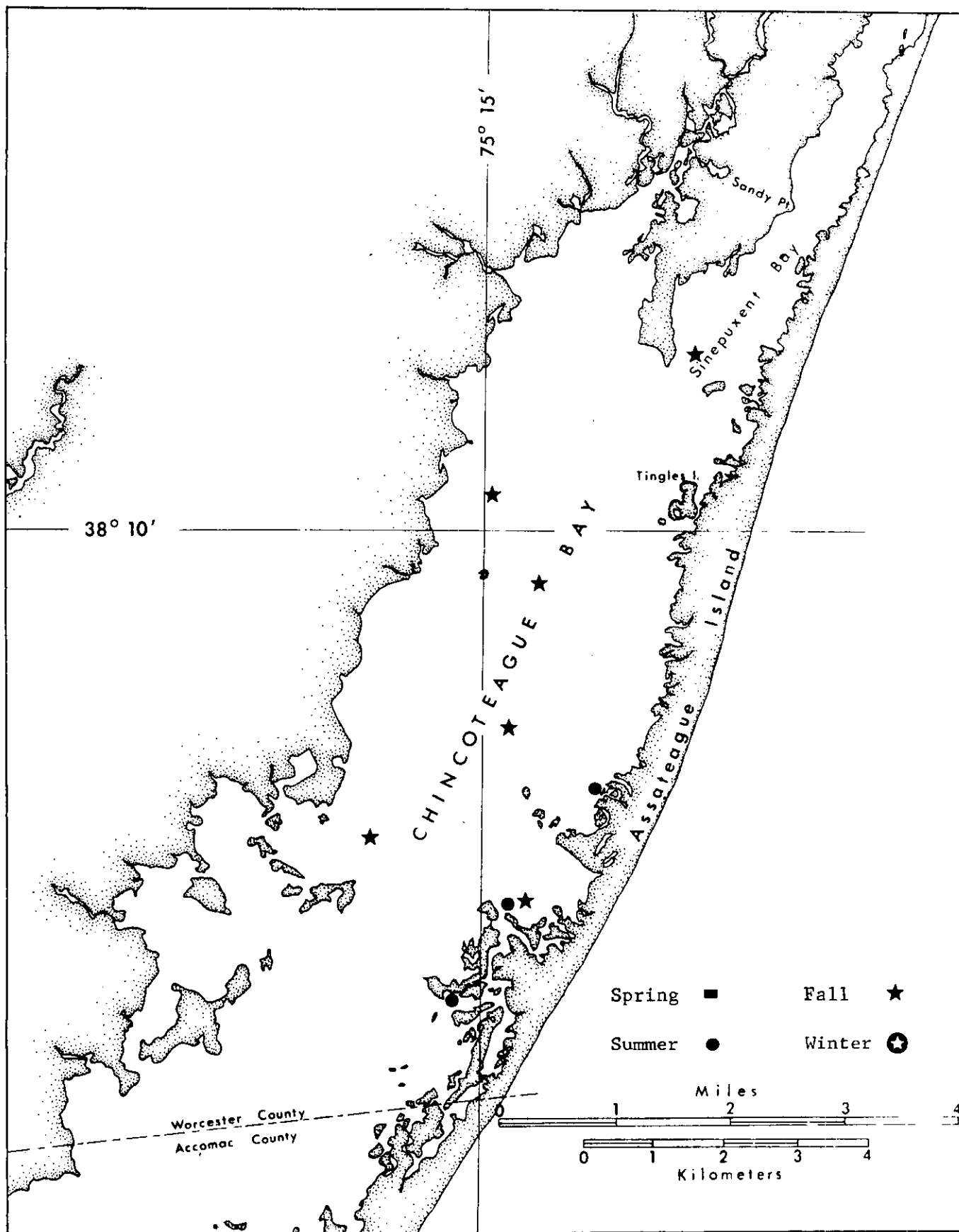


Fig. 18. Localities and season in which spot, *Leiostomus xanthurus*, was collected in Chincoteague Bay.

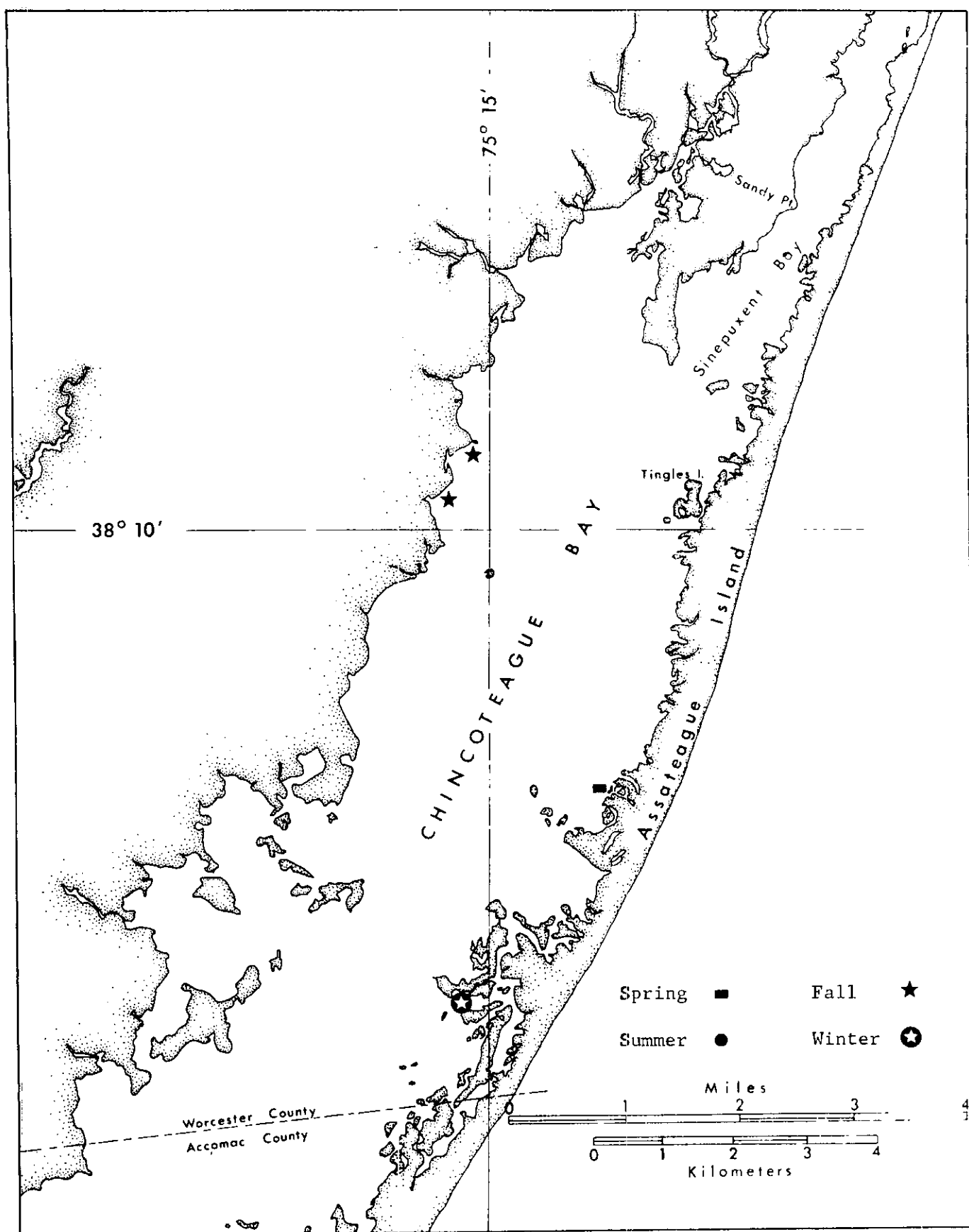


Fig. 19. Localities and season in which naked goby, *Gobiosoma boscii*, was collected in Chincoteague Bay.

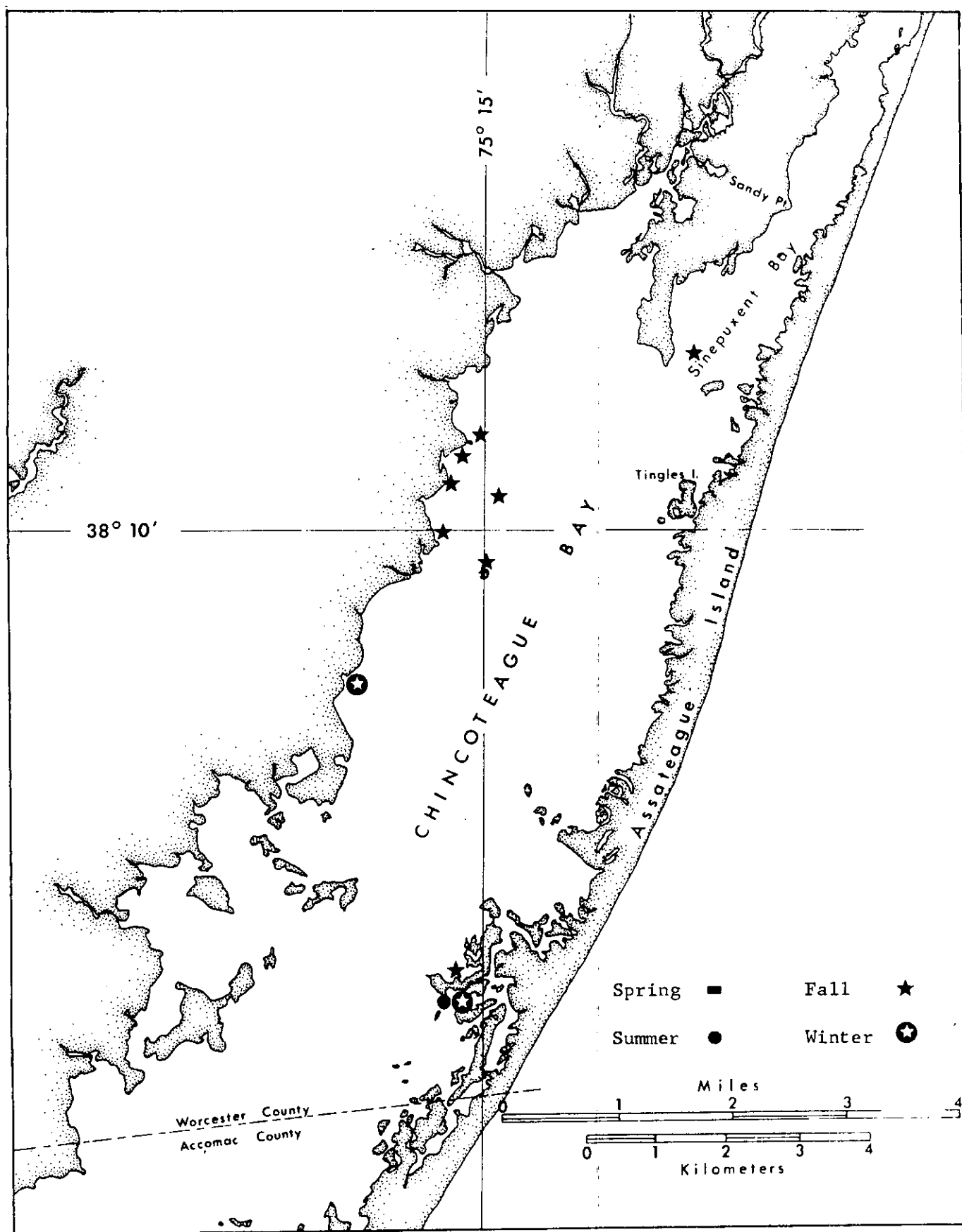


Fig. 20. Localities and season in which green goby, *Microgobius thalassinus*, was collected in Chincoteague Bay.

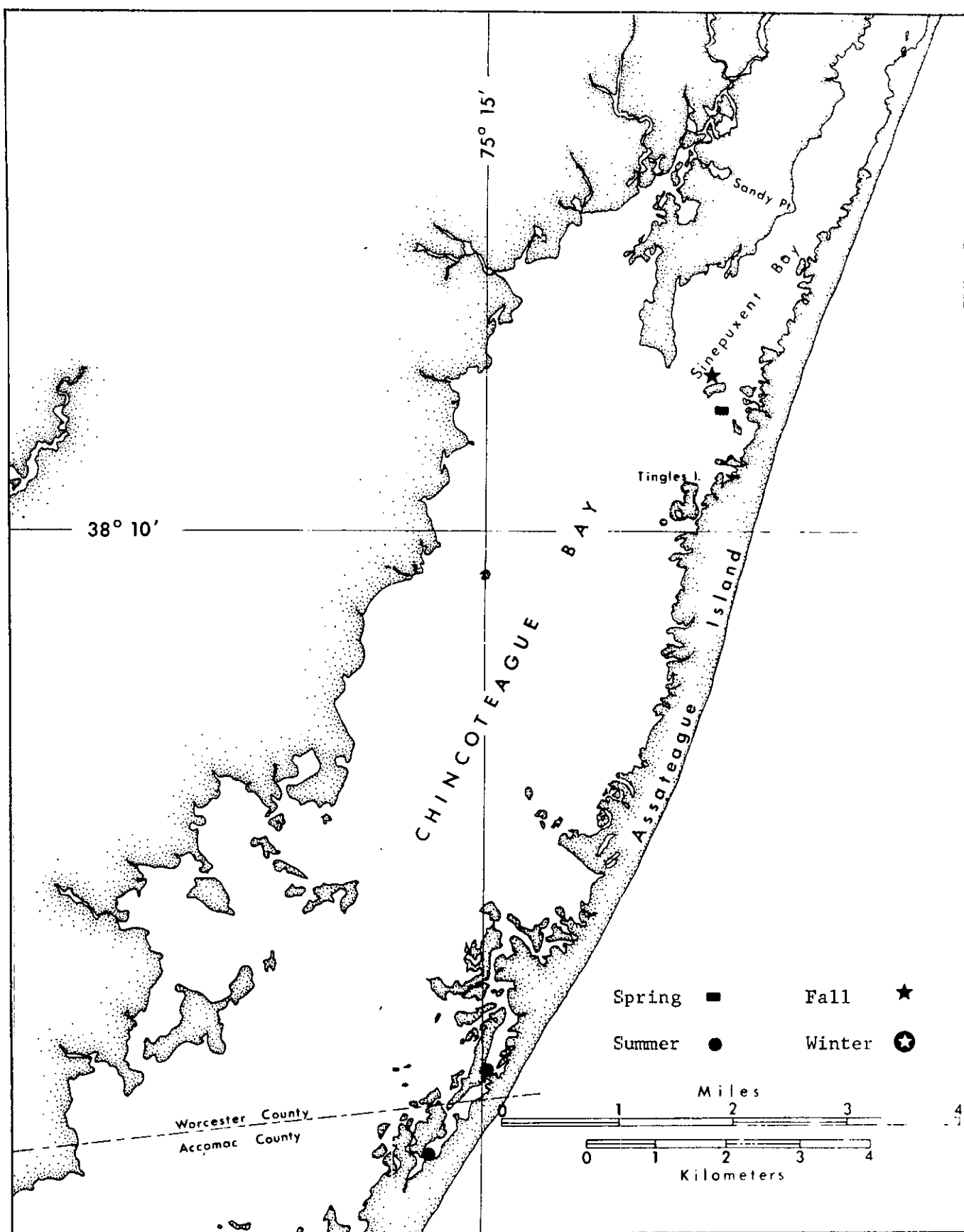


Fig. 21. Localities and season in which white mullet, *Mugil curema*, was collected in Chincoteague Bay.

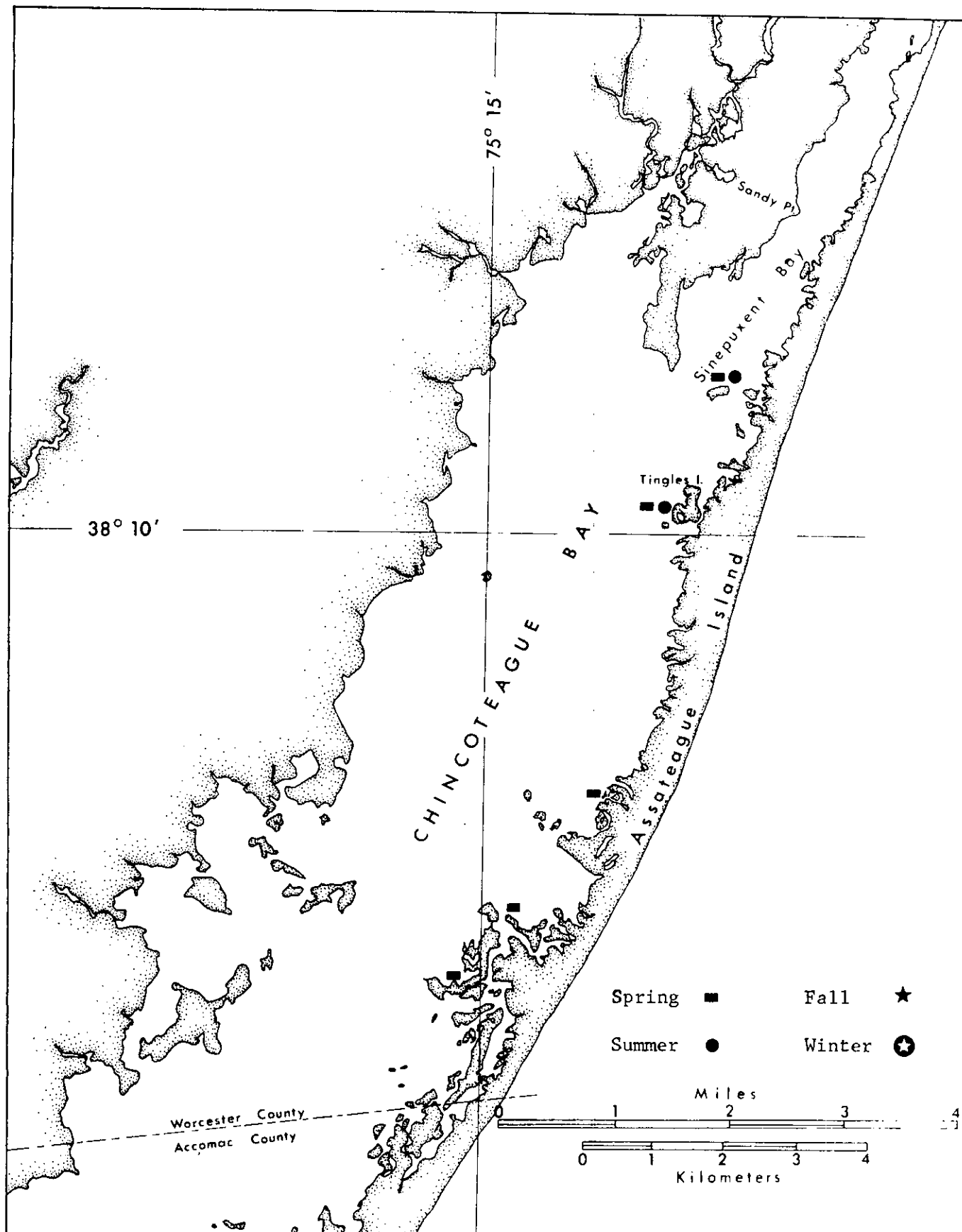


Fig. 22. Localities and season in which rough silverside, *Membras martinica*, was collected in Chincoteague Bay.

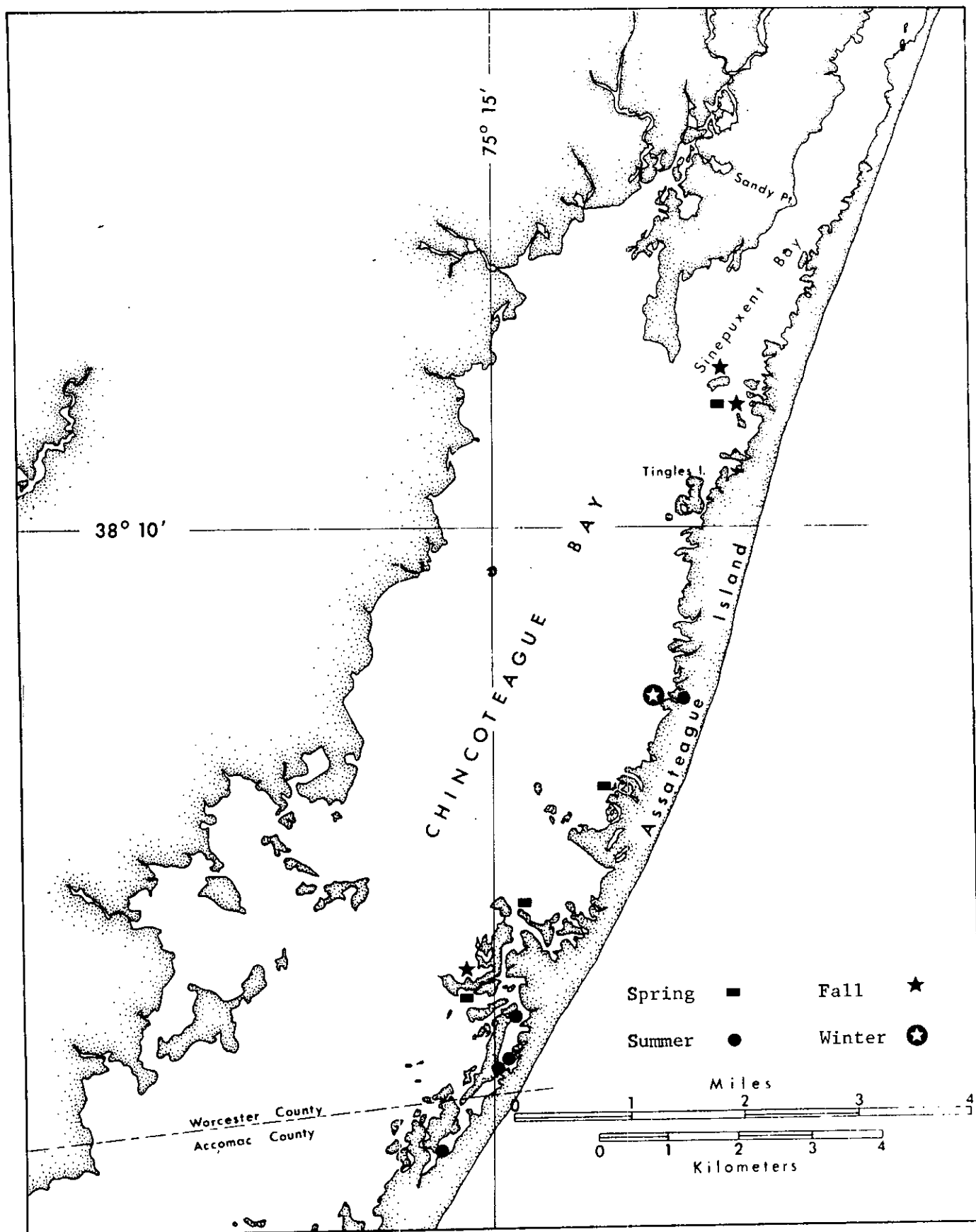


Fig. 23. Localities and season in which tidewater silverside, *Menidia beryllina*, was collected in Chincoteague Bay.

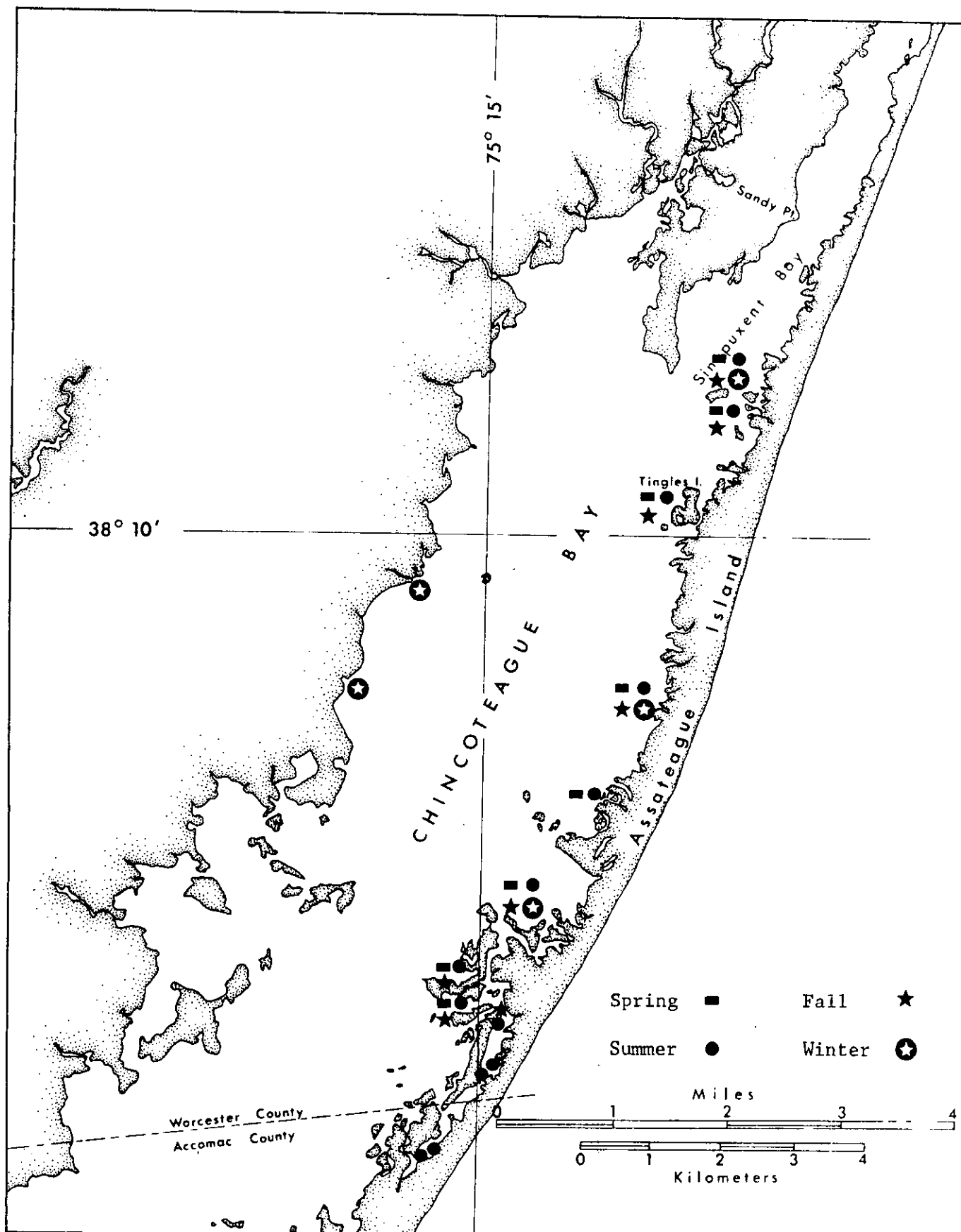


Fig. 24. Localities and season in which Atlantic silverside, *Menidia menidia*, was collected in Chincoteague Bay.

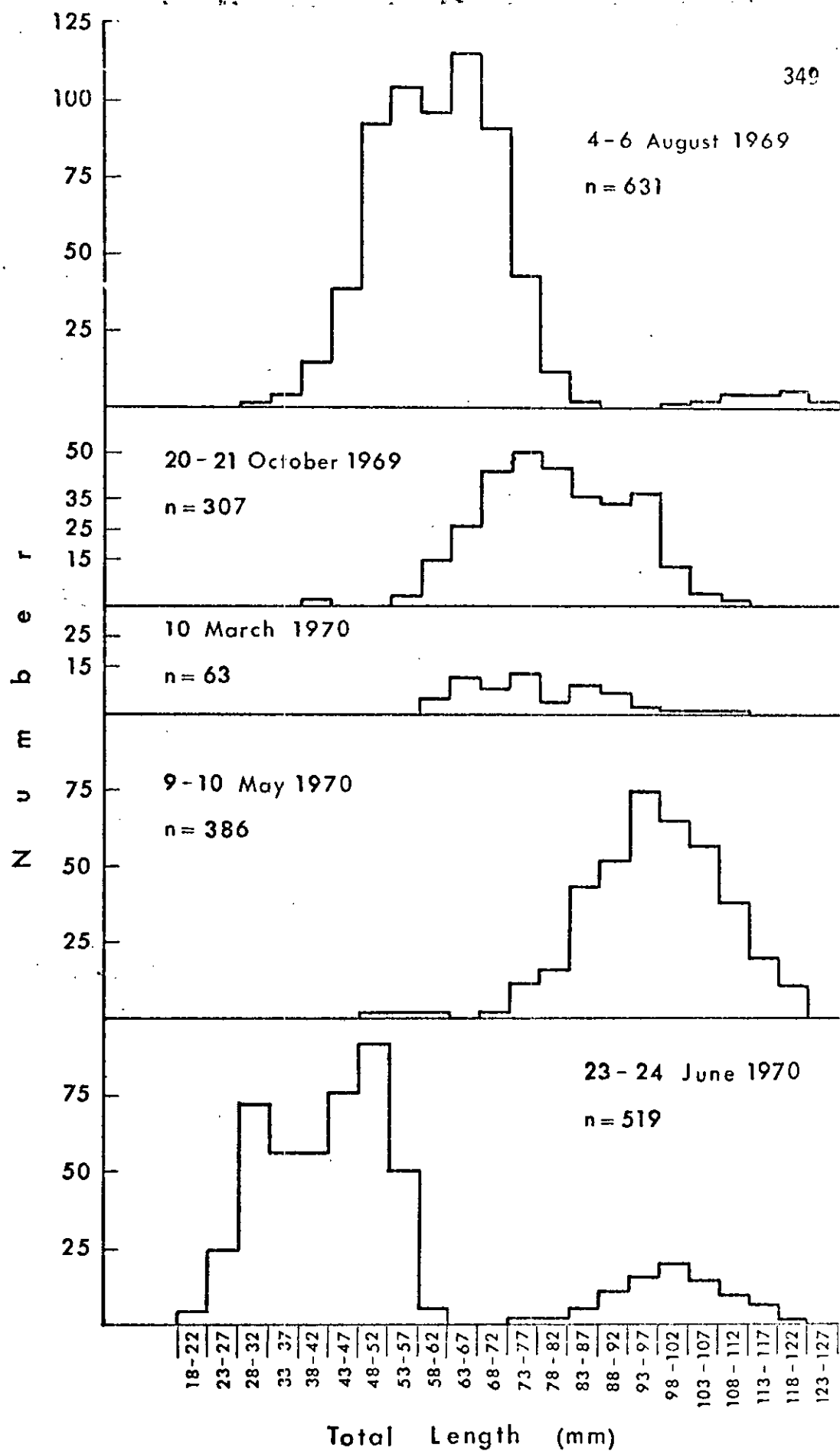


Fig. 25. Length frequency distribution of Menidia menidia in Chincoteague Bay.

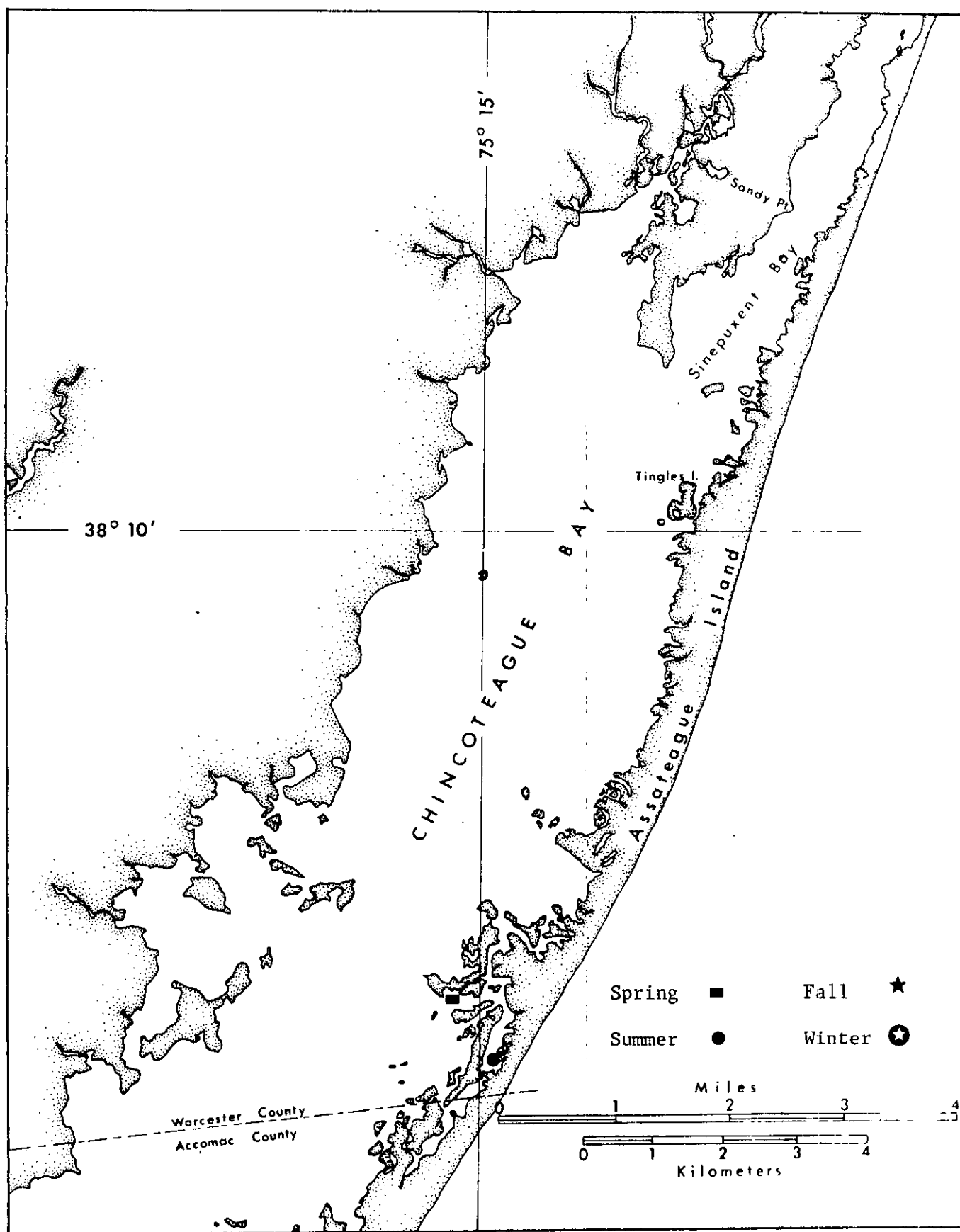


Fig. 26. Localities and season in which summer flounder, Paralichthys dentatus, was collected in Chincoteague Bay.

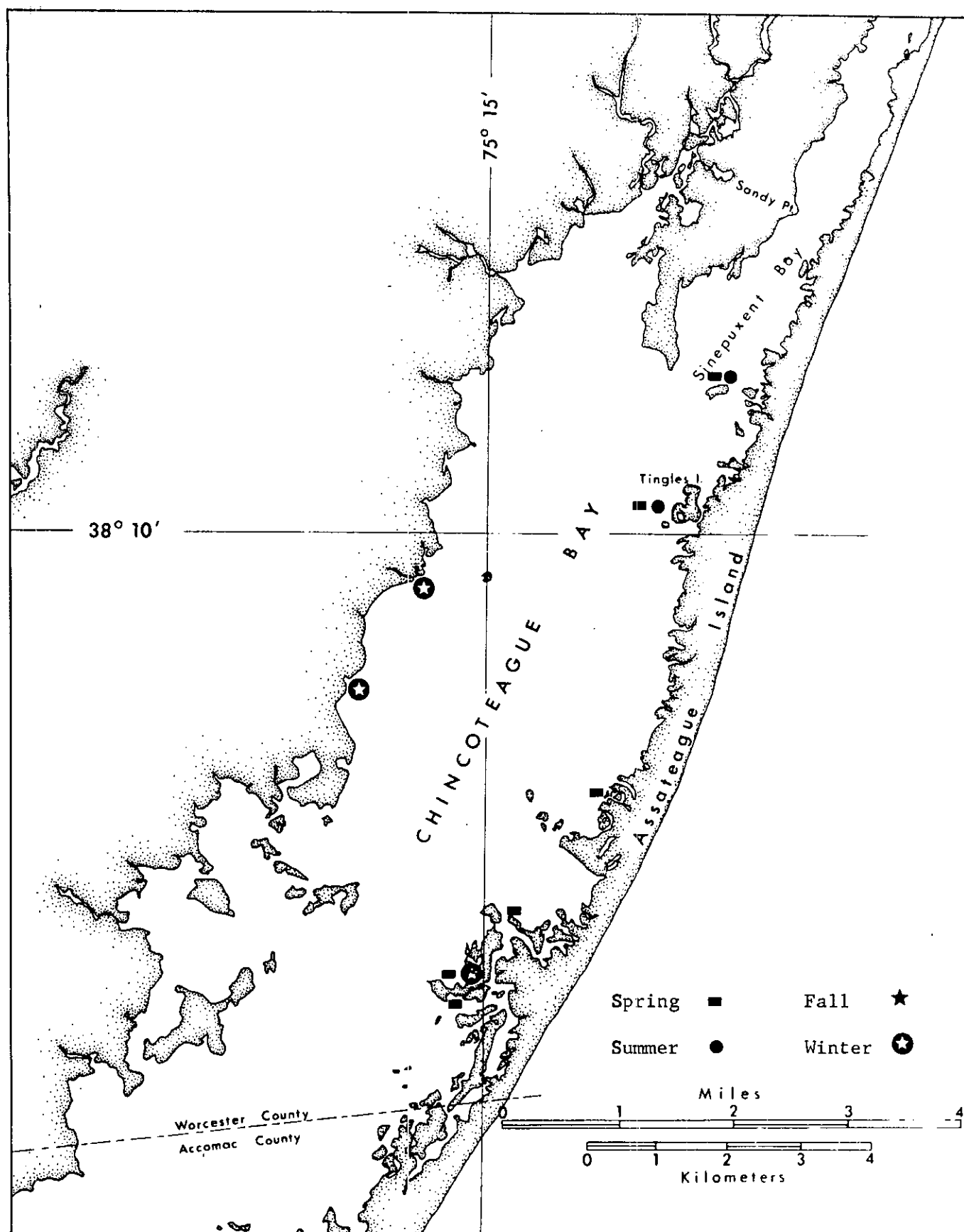


Fig. 27. Localities and season in which winter flounder, *Pseudopleuronectes americanus*, was collected in Chincoteague Bay.

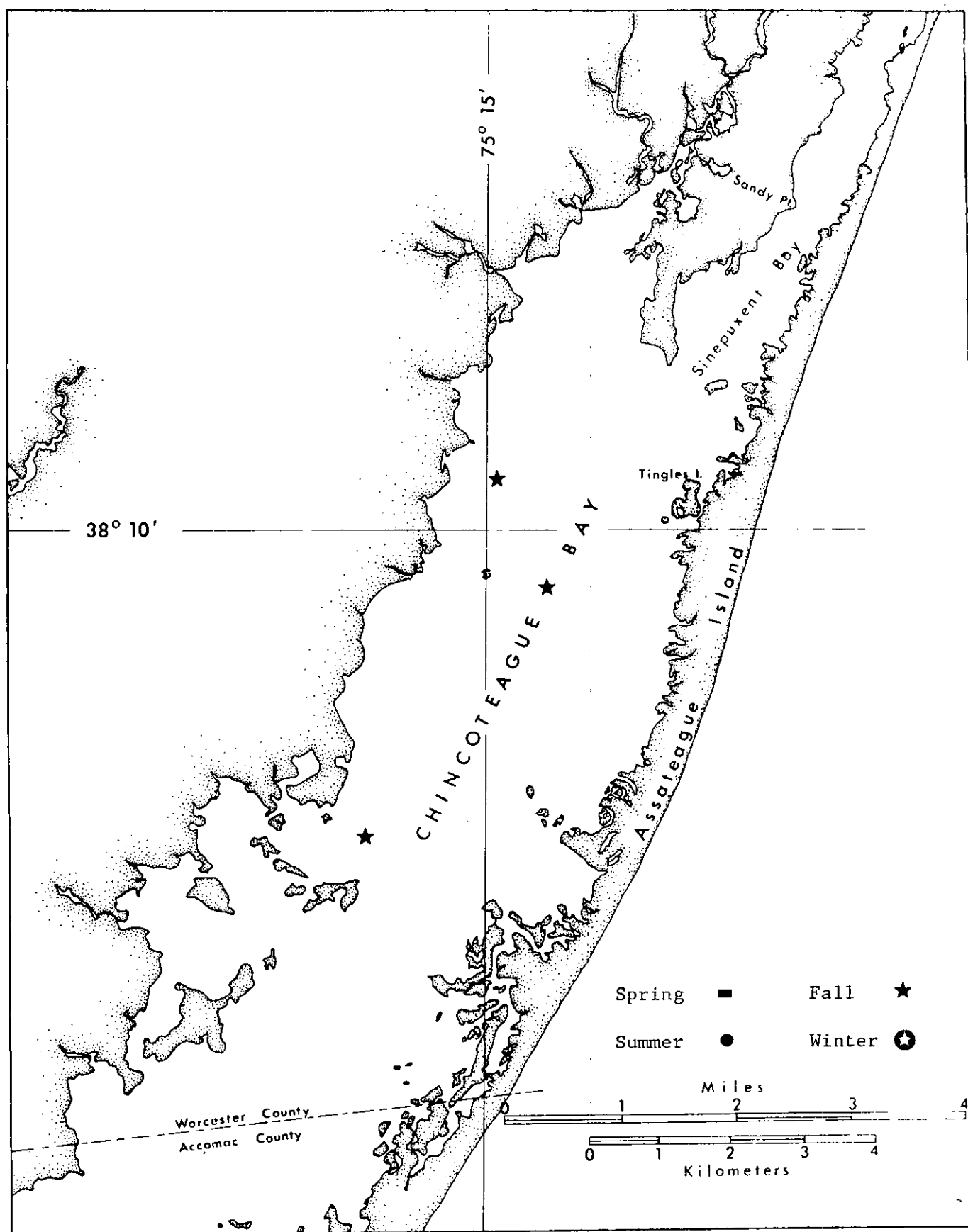


Fig. 28. Localities and season in which hogchoker, Trinectes maculatus, was collected in Chincoteague Bay.

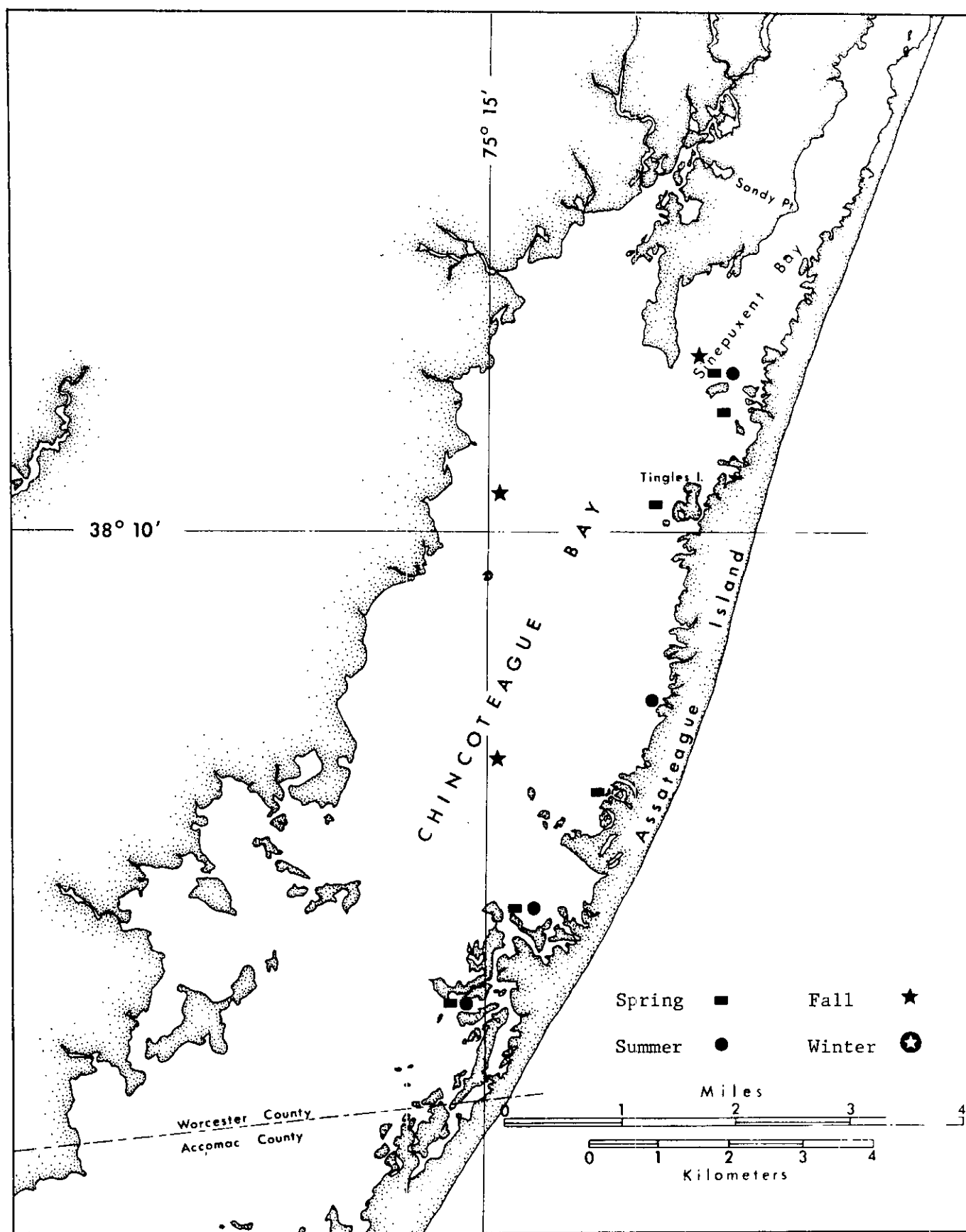


Fig. 29. Localities and season in which northern puffer, Sphoeroides maculatus, was collected in Chincoteague Bay.

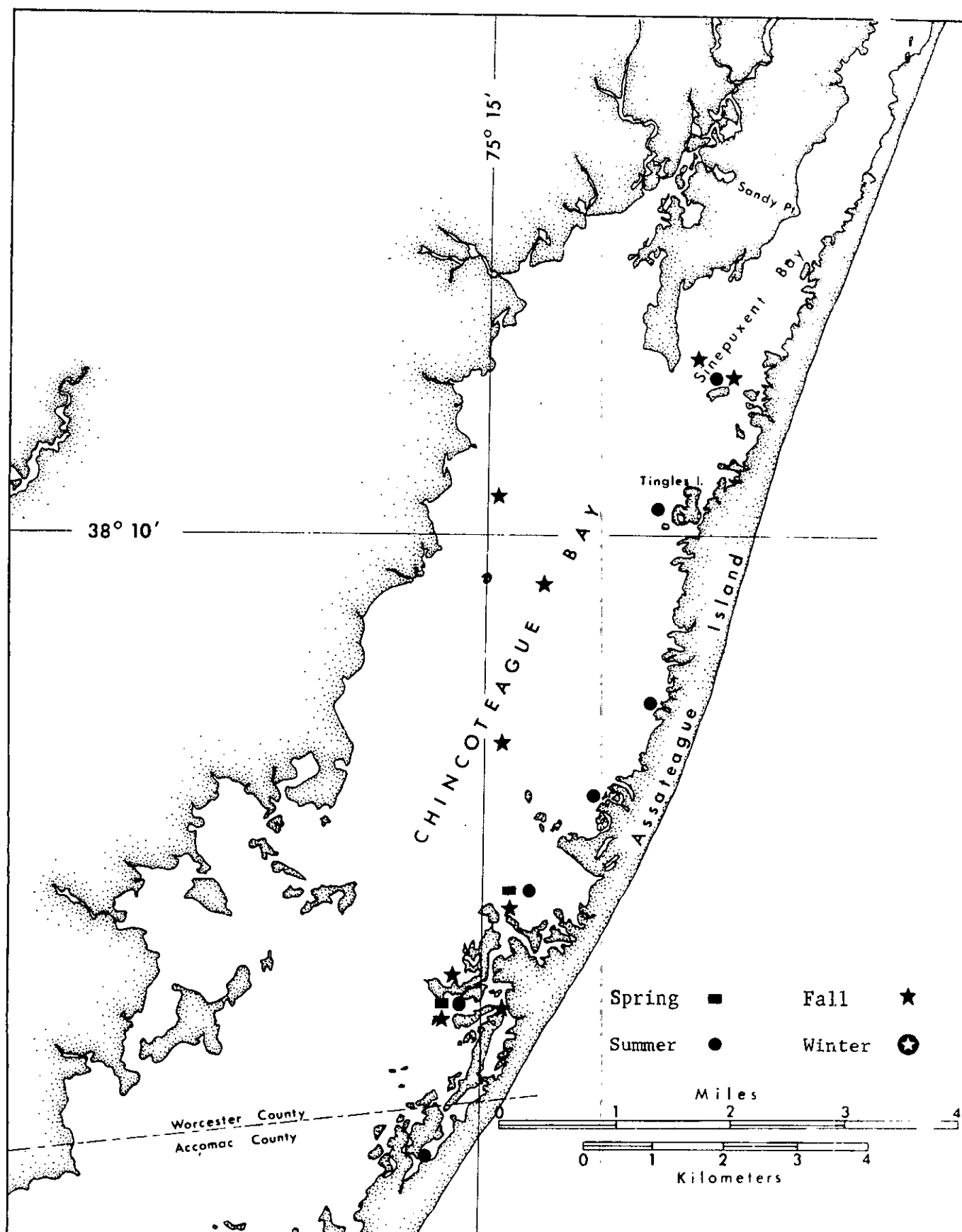
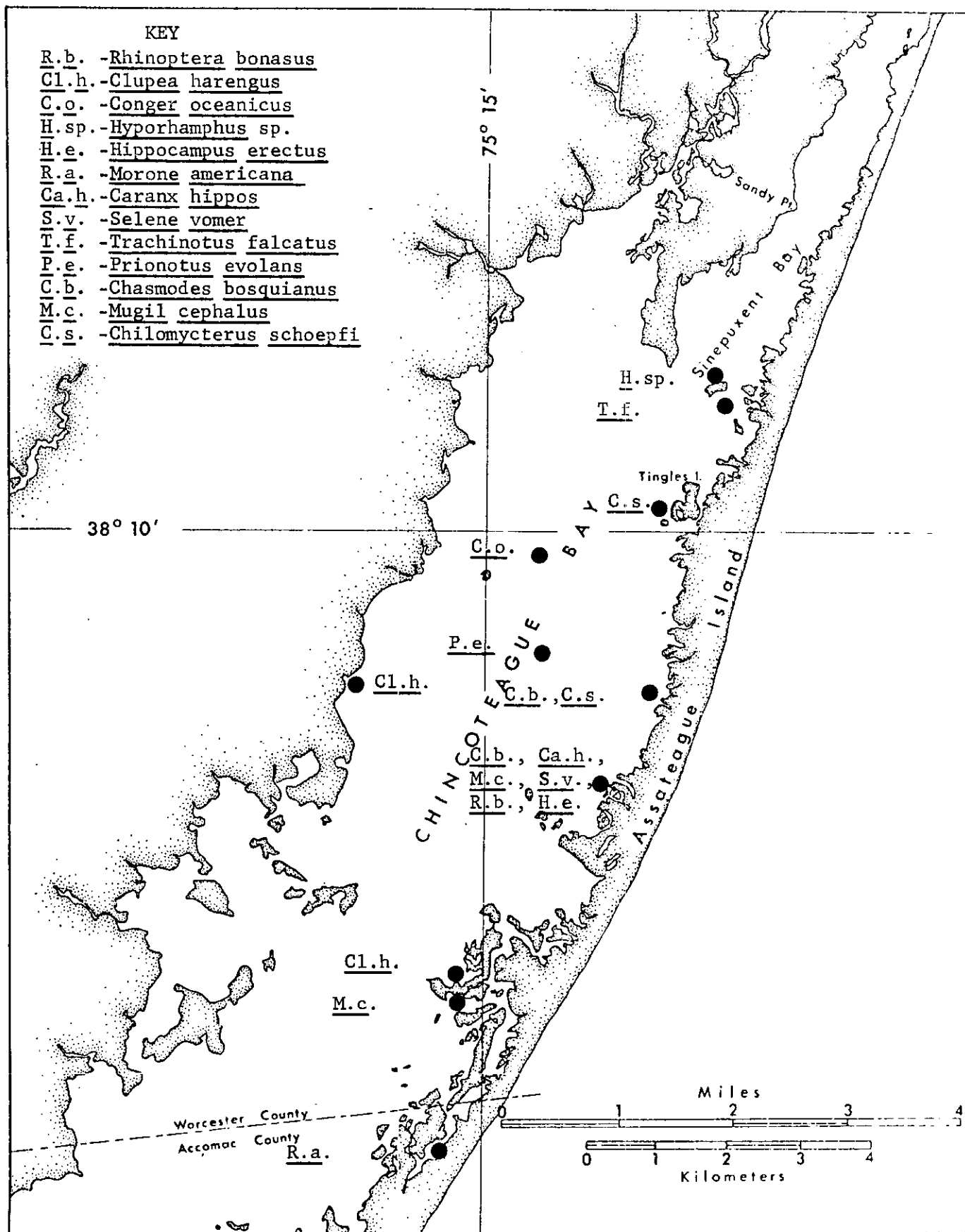
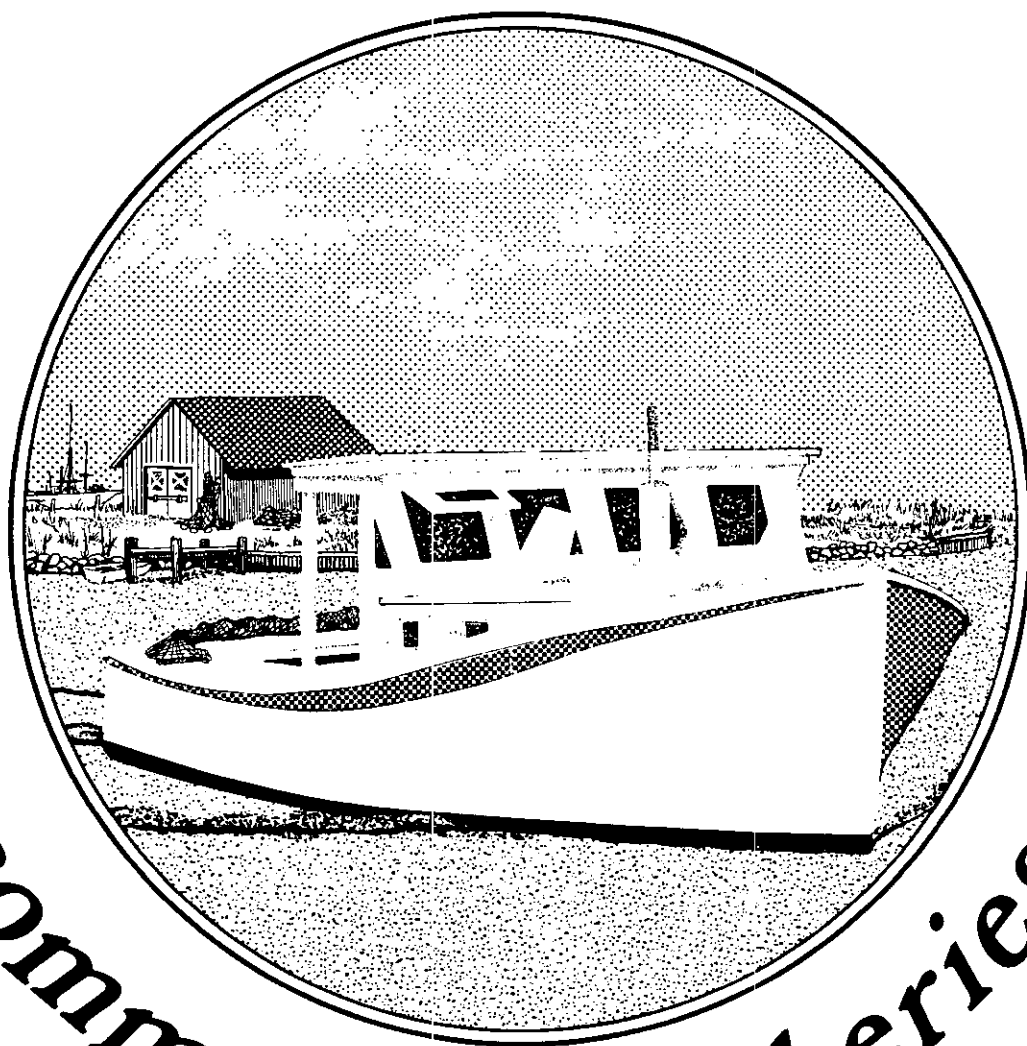


Fig. 30. Localities and season in which oyster toadfish, *Opsanus tau*, was collected in Chincoteague Bay.







commercial fisheries



J. The Commercial Fisheries of Chincoteague Bay -
Past, Present and Future

Walter Boynton

INTRODUCTION

The Chincoteague Bay commercial fishery, while not large, is quite diverse. It includes in its catch a variety of finfish, oysters, clams, crabs, and other less important species. The fishery has been operating since at least 1890 at various levels of intensity. During this time, many manual and mechanical methods have been utilized to obtain a catch, the most recent addition being the hydraulic clam dredge. Undoubtedly, the fishery has affected the biota over the years by removing only selected species, altering the position of bottom sediments and through less obvious means. With the establishment of the National Seashore, an estimated 3.5 million people will visit the area and place additional demands on the estuary as a non-extractive resource; that is, for purposes of waste disposal, dredging, and recreational uses. It is possible that the use of the Bay as a fishery and as a non-extractive resource will result in a conflict.

A complete analysis of the interaction of the two operations is beyond the scope of this paper and indeed, inhibited on any level by the lack of knowledge of certain fundamental processes. However, a description of the development of the fishery to the present in terms of catch records, fishing methods, laws, and research efforts designed to improve the industry will provide baseline information that can be utilized in assessing the possible effects of park management decisions on the fishery and, conversely, the effects of the fishery on the park system.

OYSTERS

Oysters (Crassostrea virginica) have long been the most important fishery product of Chincoteague Bay. Old records show yields as high as 2,250,000 pounds in 1897 (Murphy, 1960). After the turn of the century, production sharply decreased and annual yields averaged slightly less than 500,000 pounds. No catch records are available between 1940 and 1950, but for the past twenty years, catches ranged between 650,000 and 193,800 pounds with the average being about 330,000 pounds (Maryland Landings, 1960-1968). Figures are not yet available for all of 1969, but through July a total of 120,800 pounds of oyster meat had been harvested and was valued at \$218,900 (Maryland Landings, 1969). In recent years, the total value of the catch has increased somewhat, but fewer oysters have been harvested. For instance, in 1960 the yield was 371,016 pounds valued at \$418,571, while in 1968 the catch was only 220,351 pounds but was valued at \$468,750. In 1968 the yield from Chincoteague Bay was about 1.5% of the total annual Maryland production by weight and constituted about 5% of the total value of the catch (Maryland Landings, 1969).

Before the Ocean City Inlet was created in 1933, the salinity in parts of the Bay was low enough for natural oyster populations to exist free from heavy oyster drill predation. Shortly after the inlet was formed, the natural oyster populations in the Maryland section of the Bay sharply declined, mainly because of increased predation (Mr. Elgin Dunnington, personal communication). Intense drill control efforts and more refined harvesting methods were sufficient to maintain the natural oyster industry in the Virginia portion of the Bay. In 1958 the industry suffered another

serious set-back. During the summer, mortalities ranging from 50% to 100% occurred throughout the Bay. A highly significant percentage of the dead oysters were infected with MSX (Minchinia nelsoni), a haplosporidian protozoan parasite (Sieling, 1969). MSX may have been present in the Bay for some time prior to its discovery in 1958, but the high mortalities of 1958 attributed to MSX at least indicate a great increase in activity. Apparently, the combination of MSX infections, predation, and strong competition from other benthic invertebrates for bottom space virtually eliminated all natural oyster populations in the Bay (Mr. Elgin Dunnington, personal communication).

The Chincoteague oyster had become famous long before the Ocean City Inlet initiated a decline in natural oyster populations. At an undetermined date (prior to the inlet formation), the demand for local oysters became great enough to justify the importation of oysters from the Chesapeake Bay or the Virginia seaside to supplement the existing stock. Today the entire industry depends on the importation of oysters from other areas.

Because the industry is based on private plantings, it is quite localized. Oyster plantings are made in areas that are favorable to oyster production and readily accessible to the oystermen. The degree of localization has varied over the years and, at present, the industry is limited to the southern parts of the Bay. In 1960 (Sieling, 1960) the area above Ocean City Inlet produced "salts"^{1/} with some salts being produced in Sinepuxent Bay. Barrel-stock oysters^{2/} were produced along the western shore

^{1/}

Salts, or shucking oysters refer to clumps or aggregations of oysters. They are generally shucked and processed rather than eaten on the half-shell.

^{2/}

Barrel-stock oysters refer to single oysters. They are packed in barrels after harvesting, and usually eaten on the half-shell.

and there was considerable production of both salts and barrel-stock oysters in the southern portions of the Bay (George Ward, personal communication). At that time, very few oysters were planted in the central portions of the Bay (Sieling, 1960). Today, the majority of the barrel-stock oysters are produced at Taylor and George Island Landings, with a few being produced at Franklin City and Scotts Landing. There is no oystering presently north of Scotts Landing. The area around the town of Chincoteague produces both barrel-stock and salts, but most of the commercial activity is with salts.

Barrel-stock oysters are produced from seed oysters, usually brought in from the Chesapeake Bay. The oysters are purchased when the price of Chesapeake oysters is lowest, usually in the fall or early spring, transported to Chincoteague on barges and then set out on the bottom for periods of time varying from a few weeks to six months or more. After being on the bottom for a period of time, the oysters are harvested with hand tongs or dredges, brought to the oyster-house, and culled into three sizes--primes, cullentines, and seconds. The oysters are then either washed and barreled, or placed on floats until they are needed. By stockpiling oysters on the floats, winter dredging operations are minimized and the industry can operate all year, regardless of weather conditions (Mr. Jones, personal communication).

The salts, or shucking oysters are clusters of oysters grown in the Chesapeake Bay or along the Virginia seaside. These oysters are bought whenever prices are low, transported to Chincoteague Bay, and set out for as long as 18 months. The oysters are then harvested with power dredge boats and transported to the shucking houses for final processing (Sieling, 1959).

Frequently, salts are not set out at all, but shucked as soon as they are bought. The reason for bypassing setting-out is that shucked oysters are washed before being packaged. During the process, much of the salt that has accumulated in the meat is removed, thus negating the favorable effect of exposing the oysters to high salinity waters. Furthermore, shucked oysters are usually cooked in some way rather than eaten raw. Cooking further negates any favorable effect that setting-out would produce. The shucking industry is considerably larger than the barrel stock industry, and is centered around the town of Chincoteague, Virginia.

Inspection of the western shore of the Bay reveals that the industry was once far more extensive than it is at present. While the annual value of the catch has remained the same or increased slightly over the past 10 years, production has gradually decreased (Murphy, 1960). The famed Chincoteague oyster industry has long been beset by a variety of "natural problems," some of which could be controlled and others which cannot be controlled at this time (Sieling, 1961, 1954, 1955, 1960). Research conducted at the former Maryland Department of Research and Education Public Landing Station from 1951 through 1936 (Truitt, 1952) identified the organisms that limited oyster production, tested and evaluated methods to control or avoid the effects of these organisms, and conducted preliminary experiments directed towards developing methods for producing seed oysters and disease-resistant strains (Cronin, 1955). Although some of the research did not yield conclusive results, a significant amount of useful information was obtained. This information included methods for attracting larger sets of oyster spat (Cronin, 1957, Truitt, 1954, Sieling, 1956, 1958),

and eliminating or avoiding oyster predators (Cronin, 1955, 1957, Truitt, 1952, 1954, Carriker, 1956, Sieling, 1956, 1955, 1954, 1960). In addition, preliminary experiments indicated that spat could be produced in Chincoteague Bay by instituting an oyster hatchery program (Beckett and Hidu, 1967). In 1961, the Public Landing Station of the Maryland Department of Research and Education published a report entitled "Possibilities for Improvement of Worcester County Fisheries." The report outlined procedures that could be immediately instituted to improve the industry, suggested various management procedures that should be adopted, and listed research projects that would further benefit the industry. Unfortunately, the industry has been very slow to adopt new methods.

Notwithstanding the predator and disease problems, the fishery could be more developed than it is at present. It seems that a major factor limiting growth is the high cost of labor needed to handle the oysters from the time they are purchased, until sold. If this problem could be avoided, the industry could realize more of its potential.

TABLE 1. OYSTER CATCH FOR THE YEARS 1960 to 1969.

<u>Year</u>	OYSTERS	
	<u>Pounds</u>	<u>Value</u>
1960	371,016	\$418,571
1961	359,086	405,903
1962	214,200	309,828
1963	217,055	292,043
1964	246,229	379,860
1965	282,100	433,268
1966	420,409	709,230
1967	209,880	385,150
1968	220,351	468,750
1969	120,800	218,900 * through July, 1969.

Maryland Landings Annual Summaries, 1961-1969.

BLUE CRABS

Old records (Murphy, 1960) indicate that the blue crab (Callinectes sapidus) has been an important fishery product of Chincoteague Bay at least since 1890. Between 1929 and 1958, the catch ranged from slightly less than 1,000,000 pounds to over 3,000,000 pounds (Murphy, 1960). Sieling reported that in 1960 the catch contributed about 8% of the annual Maryland production (Sieling, 1960). Rough estimates indicate the 1967 and 1968 catch contributed about 1% of the total annual Maryland production (Maryland Landings, 1967).

Most of the crabs caught in the bay are shipped to Chesapeake Bay processors. A few are sold alive to the hotel and restaurant trade, and some are processed at a local shucking house operating at George Island Landing (Sieling, 1960).

In 1969, there were 92 crab pot licenses issued in Worcester County. Commercial crabbers operated out of Public Landing, Tanhouse Creek, Taylor Landing, George Island Landing, Greenbackville, Chincoteague, Ocean City, and other areas along the western shore of Chincoteague and Sinepuxent Bays. There were also 10 to 18, and possibly more, Somerset County crab potters who came over to Chincoteague Bay and were the source of much ill feeling in the area (James Casey, personal communication).

The crabbing season in Maryland extends from April 1 through December 31, except in the waters of Worcester County (Department of Chesapeake Bay Affairs, 1968). Thus, Worcester County is the only part of Maryland that can produce a commercial winter crab catch. However, winter

crabbing activity is very light. Occasionally, fishermen find a pod of wintering crabs in the lower bay and dredge the area while the supply lasts. The time required to find a pod of wintering crabs and low market prices resulting from ready supply of crabs produced from winter crabbing activities in the Virginia waters of the Chesapeake Bay combine to make winter crabbing in Chincoteague Bay generally unprofitable (Mr. George Ward, personal communication).

Crabbing activity on the bay is variable even in the summer months, when crabs are readily taken in crab pots. This situation results from the fact that frequently female crabs are small, often under legal size, when mature. Even though minimum size laws do not apply to crabs taken in Chincoteague Bay, the small size makes them commercially less desirable.

Most of the commercial crabbing is done during the early spring and during the peeler^{1/} season. Generally, crabs appear in Chincoteague Bay before they appear in the Chesapeake. At that time of the year, there is a good market for crabs and despite their small size, Chincoteague Bay crabs command a good price, sometimes as high as \$14 per bushel (George Ward, personal communication). Following the early crab season, most of the commercial activity is centered on the soft-crabs, or peelers, taken in the central portions of the bay. Crabs in the Chincoteague area tend to molt at the same time and thus, peelers can be obtained in great numbers. Often, a crabber can get 1,200 soft crabs in a day and obtain 10-12 cents per crab. However, the peeler season is short, usually lasting only a few

^{1/}

Peeler refers to a crab that is in the process of shedding its old shell.

weeks. After this, the larger and more desirable Chesapeake Bay crabs become available in large numbers, and the price per bushel for local crabs drops rapidly. Some crabbing is done in the late fall when prices tend to be higher, but late season crabbing is not extensive (George Ward, personal communication).

A considerable amount of research on the blue crab was conducted in Chincoteague Bay in the late 1950's and early 1960's. Information has been collected on the morphometric characteristics of adult female crabs in the bay area. In the 1960 Maryland Department of Research and Education series, Sieling summarized the findings at that time and stated that: (1) There is a wide variability in the sizes of adult female crabs as reflected by their length. Of 42 samples averaging 90 crabs each, mean lengths of these samples ranged from less than 55 mm to almost 64 mm. (2) The adult female crabs in Chincoteague Bay are considerably smaller than those of the Chesapeake, averaging 58.5 mm in length, while those of the Chesapeake average about 65 mm. The results indicated that about 17% of the adult female crabs averaged below the 5" minimum legal limit in Maryland. Since that time, the minimum size law has been amended and does not apply to female crabs taken in the waters of Worcester County.

In 1958 a blue crab tagging survey was completed in Chincoteague Bay (Cargo, 1958). Chincoteague Bay differs considerable from Delaware and Chesapeake Bays, both hydrographically and biologically, but the adult female crabs in Chincoteague Bay still follow a southerly migration during the late fall to spawning areas in lower Chincoteague Bay. The reasons for this migration pattern could not be easily attributed to salinity

gradients which seem to be the stimulatory factors in the Chesapeake and Delaware Bays. Additional research efforts directed toward discovering the factors controlling the southerly migration of female blue crabs would be of interest. It was also noted that since the crabs do migrate between Bays, interbreeding and mixing is possible and may have an effect on the size characteristics of the population.

TABLE 2. CRAB CATCH IN POUNDS OF MEAT FOR THE YEARS 1950 to 1969.

Year	Pounds		Value	
	Hard	Soft	Hard	Soft
1950	3,757,300	25,544	\$ 91,562	\$ 3,780
1951	2,377,200	94,836	78,448	16,596
1952	1,652,700	24,632	73,100	3,400
1953	3,348,300	30,277	133,932	4,814
1954	1,100,500	1,587	46,221	270
1955	780,600	1,600	46,900	336
1956	752,100	2,900	52,647	2,639
1957	984,500	43,400	58,850	8,680
1958	1,580,100	92,900	66,833	14,904
1959	448,400	10,600	32,028	2,115
1960	511,277	1,386	28,632	277
1961	222,250	2,940	10,297	766
1962	214,900	4,698	13,753	940
1963	202,235	3,267	12,134	1,210
1964	242,450	672	17,616	214
1965	754,536	39,001	58,851	30,341
1966	145,350	1,461	9,882	557
1967	207,300	9,789	15,201	3,333
1968	119,400	--	13,472	--
1969 - Jan.	--	--	--	--
Feb.	--	--	--	--
Mar.	--	--	--	--
Apr.	53,250	--	9,053	--
May	7,940	--	1,588	--
June	6,250	--	1,000	--
Jul.	8,500	--	1,020	--

* 1950-58 from Murphy, 1960

1959-60 from Md. Landings Annual Summaries, 1959-60.

HARD CLAMS

The hard clam (Mercenaria mercenaria) has been an important commercial species in Chincoteague Bay for some time. Between 1940 and 1968, commercial catches ranged between 60,000 and 250,000 pounds per year with the catches being reported in recent years (Murphy, 1960). In 1953 the Shinnecock rake was legalized and the catch went up appreciably, as compared to previous years (Sieling, 1958). Hard clam landings in 1967 increased by 124,000 pounds of meat above the production recorded for 1966. In October, 1967 hydraulic dredging for hard clams was permitted by Maryland laws, and was the principal reason for the increase (Maryland Landings, 1967). In 1968, the last year for which complete catch records are available, the total Maryland production was 525,519 pounds of meat, valued at \$292,421. The yield from Chincoteague Bay and adjacent areas represented about 92% of the Maryland catch, both in weight and value.

However, these values represent commercial catch records exclusive of the catch made by summer visitors and local people, which is no small number. In 1956 the Department of Chesapeake Bay Affairs conducted a year-round survey of both commercial and recreational clamming. The study indicated that 25,000,000 clams per year were taken from Worcester County waters. This agency is presently conducting another clam survey, and in the first year of the new survey 13,699,300 clams were taken by commercial interests. Estimates have put the recreational catch at least equal to the commercial catch (James Casey, personal communication). As the commercial

catch records apparently represent but a portion of the total catch, any evaluation of the resource must take into account the tremendous number of clams being harvested by recreational clammers.

Commercial clamming is practiced year-round, using a variety of methods. In the summer, some clams are taken commercially by treading or wading, but this method is used almost exclusively by recreational clammers and is obviously limited to comparatively shallow areas. In addition to treading, some clams are taken by tonging and raking. These methods are legal throughout the year but are not widely used in this area. In cold weather the majority of the clams caught are taken with hydraulic clam dredges and Shinnecock rakes. These methods are permitted only during the period of October 15 to April 15. At the end of the 1968-69 season the following commercial hard clam equipment was active: 42 hydraulic dredges, 7 Shinnecock rakes, 3 hand scrapes, 2 clam rakes, and 2 tongs. At the beginning of the 1969-70 season the following equipment was active: 46 hydraulic dredges, 2 clam rakes, and 1 tong.

In the 1968-69 season there were 3,505 total boat-days and, of these, 1,157 boat-days had the maximum allowable catch of 8,000 clams. The twenty most active hydraulic dredges had maximum allowable catches about 60% of the time. If the new hydraulic dredges added to the fleet in 1969-70 have a good season, the total hardshell clam harvest could increase by as much as 17% (based on 1968-69 figures, James Casey, personal communication).

During times of peak production most clams are sold to local wholesalers, the majority going to Burton Company in Chincoteague, Virginia. These wholesalers either sell the clams immediately to such companies as Campbell's Soup, or replant the harvest until prices are more favorable (Maryland Landings, 1967).

At present, commercial clammers--most of them using hydraulic dredges--operate out of Public Landing, Tanhouse Creek, Taylors Landing, Greenbackville, George Island Landing, as well as Ocean City and Chincoteague, Virginia.

The principal limit to the financial growth of the industry appears to be the off-size of the majority of the catch. Frequently, the chowder clams are not large enough for true chowder cull, and the cherrystones are too large for the accepted size of cherrystone (Maryland Landings, 1968). Thus, prices paid for the catch are limited to levels where buyers can move the yield to advantage against more favorably sized clams being harvested in other areas. By late fall, in 1967 and 1968 buyers found they had their capital invested in clams they could not move to advantage, and prices were lowered from an opening price of \$18 per thousand to \$12 per thousand. In 1968 the state reduced the catch limit from 20,000 to 8,000 clams per boat-day in an effort to aid the market (Maryland Landings, 1968). The local clammers made an unsuccessful effort to further limit the daily catch in the fall of 1968. In 1968 clam dealers began a two price system; cherrystones and little-necks were bought by the thousand, while chowders were bought by the pound in the shell (Maryland Landings, 1968).

The annual value of the industry is also limited by bad weather, when clammers cannot operate their hydraulic clam rigs. In January of 1970 the clammers were able to operate their rigs for only 4 or 5 days. In the early fall and spring improved weather conditions permit greater activity, usually amounting to 3 or 4 good clamming days per week.

In 1952-53 a study was made of the clam populations and distribution through the Maryland portion of the bay (Wells, 1954). The results of the study demonstrated that distribution was well correlated with bottom type, the highest densities being found in shell bottom with sand, mud and sand, and mud, each supporting progressively less dense populations. Strong, positive correlations were also found between current and densities. A positive correlation with underwater vegetation may exist, but was not proven due to the scarcity of aquatic plants at the time. It was found that clams were excluded from areas of low spring salinities and low summertime ocean temperatures, and were generally more abundant in deeper water. Wells also concluded that man was the most important predator of the adult clam; only rare predations by other species were noted. Sieling noted that the mud crab and blue crab are the most important predators on young clams, while the clam borer, conch, and cow-nosed ray are important adult clam predators (Sieling, 1960).

A re-survey of areas previously checked for clam densities indicated that dredging and, to a lesser degree, raking significantly altered clam distribution and densities (Wells, 1954). A survey designed to evaluate the effect of hydraulic dredges and abundance is now underway.

It has been postulated that since approximately 30% of the bay is inaccessible to commercial clammers due to depth restrictions, these areas may serve as major propagation areas for clam larvae which eventually settle in nearby deeper areas. From survey work done in 1952-53 and at later dates, it has been estimated that bottom production and setting of clams has increased two to six times since 1953 (James Casey, personal communication).

TABLE 3. HARD SHELL CLAM CATCH IN POUNDS OF MEAT FROM 1958 to 1969.

<u>Year</u>	HARD CLAMS	
	<u>Pounds (Meat)</u>	<u>Value</u>
1958*	274,200	\$ 100,542
1959	136,900	59,824
1960	183,060	79,547
1961	,	
1962	372,831	173,559
1963	468,039	241,235
1964	275,133	142,538
1965	174,504	96,940
1966	146,095	81,425
1967	271,388	139,942
1968	484,068	267,028
1969 Jan.	100,704	62,940
Feb.	52,384	32,740
Mar.	104,722	58,634
Apr.	77,453	38,726
May	7,439	4,184
June	2,432	1,520
July	2,547	1,522

* 1958 from Murphy, 1960

1959-69 from Maryland Landings Annual Summaries, 1959-69.

SURF CLAM

The surf clam (Spisula solidissima) first gained importance in 1950 when local boats, converted from the otter trawl industry, entered the fishery. The surf clam industry operates offshore from Assateague Island and along the shore of the island, itself. Before 1950 the surf clam fishery was centered along the New York and New Jersey coasts but as these beds were depleted, a part of the activity shifted to beds discovered in Maryland (Sieling, 1955).

In 1952 eight boats were operating out of Ocean City, while others were working from New Jersey ports. By 1954 Ocean City had at least 11 active boats. The industry continued to prosper until 1960 when there was a severe reduction in activity due to the discovery of dense beds of clams along the New Jersey coast. While the New Jersey beds remained productive, most of the activity was centered around that area because of the close proximity of processing facilities. Only three boats operated on a part-time basis in 1960. The industry again made significant gains in 1967 and 1968. The 10 boats operating out of Ocean City in 1968 landed 5.3 million pounds of meat valued at \$883,306. Greater landings at Ocean City have recently been very important to the surf clam industry because New Jersey landings, which usually supply 90% of the national catch, decreased by 10 million pounds in 1968. In 1968, 13% of the national catch was brought in at Ocean City, and this is expected to increase to 15% in 1969 (Ropes, 1970).

Exvessel prices for smaller inshore clams are usually constant at \$1.65 per bushel while larger offshore clams sell for \$1.90 to \$2.00 per

bushel. Until recently, the catch was trucked to Delaware and New Jersey for processing. In 1968 a plant for shucking surf clams opened in Ridgely, Maryland, and is the only plant of its kind in Maryland (Maryland Landings, 1968).

Surf clams are harvested with a special type of hydraulic dredge. The dredge is 30 to 60 inches wide, has a large chain bag attached to the trailing edge, and is equipped on the leading edge with several powerful water jets. As the dredge is dragged along the bottom to depths of 100 feet, the jets loosen the clams which are then collected in the chain bag. Sieling reports that as many as twenty bushels of clams are collected in a single drag (Sieling, 1955).

The surf clam competes favorably in the market with other clams because it is cheap and, once processed, makes an acceptable product. The meat has a variety of uses, including chowder cull, clam cakes, deviled clams, clam juice, and fish bait (Sieling, 1955). The clam is not sold on the fresh food market.

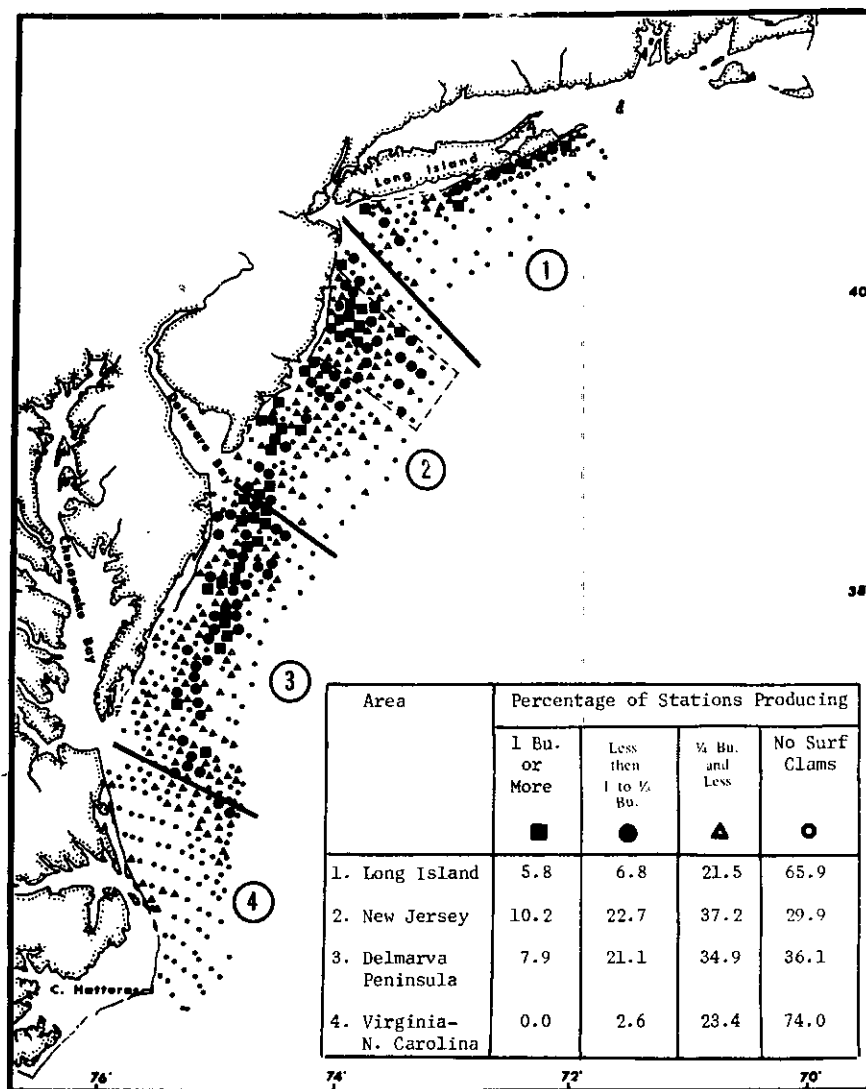
The surf clam is larger than the hard-shell clam and has a thinner shell. It is found from New England south to North Carolina on sandy beds from 3 to 70 miles offshore, and in water 20 to 100 or more feet deep (Sieling, 1955). In its more southern range the surf clam has two spawning periods, one in June-July and another in September-October.

The relative abundance of surf clams in depths from 40 to 480 feet has been determined from recent Bureau Commercial Fisheries surveys. The areas of greatest abundance are along the New Jersey coast, with moderate concentrations being found in waters 70 to 90 feet deep off Chincoteague, Virginia. Sampling for young clams in the Chincoteague area indicated a

density of 1 to 2 million juvenile clams per mile of beach. Growth studies conducted in 1963 indicated that surf clams can reach a favorable commercial size of 5 inches in 5 years. The BCF Laboratory at Oxford conducted studies that showed that in natural environments clams reach a length of 1 3/4 inches by the end of their first year (Yancy and Welch, 1968). The growth rate appears to be appreciably higher in Maryland waters than in New England waters.

While the relative abundance, rate of growth, and double spawning periods favor large populations of surf clams, predation and storm damage act to limit population size. Natural predators include bottom-feeding fish, ducks and gulls, and moon snails that bore holes through the shells and eat the meat. Storms wash ashore tremendous numbers of clams, all of which die, once exposed. After a winter storm in 1920, it was estimated that 5 million clams per mile of beach were washed ashore (Yancy and Welch, 1968).

Since 1963 the Oxford, Maryland laboratory of the Bureau of Commercial Fisheries has been studying the ecology of the surf clam, determining the amount and location of surf clams, and determining the reproductive rates, growth rates, and death rates. Most of the information reported here was developed at the Oxford Laboratory. This research, when completed, will make it possible to estimate natural and commercial mortalities and provide answers to such management problems as the time required for replenishment of fished grounds, and the fishing intensity that can be maintained without depleting stocks. Available data now indicates that the Delmarva Peninsula can support greater fishing efforts (Ropes, 1970).



1. Surf clam abundance and distribution in four Middle Atlantic areas: (1) Long Island, (2) New Jersey, (3) Delmarva Peninsula, and (4) Virginia-North Carolina. Taken from Ropes, John W., Chesapeake Bay Affairs-Commercial Fisheries News.

TABLE 4. SURF CLAM CATCH IN POUNDS OF MEAT FOR THE YEARS 1953-1969.

Year	SURF CLAMS	
	Pounds	Value
1953*	1,585,932	\$ 185,025
1954	1,346,136	168,267
55	1,694,592	141,216
56	1,850,328	172,633
57	1,400,664	134,090
58	791,479	92,845
59		
60	419,492	33,741
61		
62	74,902	5,984
63	64,107	5,227
64	37,808	3,337
65	274,754	21,549
66	63,580	5,535
67	1,149,194	106,367
68	5,328,382	535,772
69 Jan.	233,682	23,968
Feb.	330,242	35,405
Mar.	426,088	51,400
Apr.	483,837	58,476
May	722,483	87,307
June	778,566	93,390
July	696,252	87,524

* 1953-58 from Murphy, 1960
 1960-69 from Maryland Landings Annual Summaries, 1960-69.

FINFISH

Finfish are taken commercially from both Chincoteague Bay and the adjacent ocean. Although almost all the commercial finfish activity is now in the ocean, records (Murphy, 1960) indicate that in the early 1900's the bay supported a large commercial finfish industry. Several factors contributed to the decline of the bay fishery and the subsequent creation of an ocean fishery. The permanent opening of an inlet at Ocean City in 1933 produced profound changes in the fish fauna of the Bay, as the salinities were much lower before the inlet creation than they are today. Commercial catch records indicate shifts of populations that once inhabited the Bay in great numbers:^{1/} Shad (commercial catch of 51,800 pounds), alewives (592,000 pounds), pike (54,025 pounds), yellow perch (72,000 pounds), white perch (77,680), catfish (20,000 pounds), (Schwartz, 1961). A second factor that may have contributed to the decline in the number of commercially valuable species was disappearance of the beds of eelgrass during the 1930 epidemic that killed most of the eelgrass along the eastern seaboard (Burkholder and Doheny, 1968). Local fishermen report that shortly after the disappearance of the eelgrass, commercial quantities of such species as sea trout, mullet, and bluefish were no longer available. At present, there is some sport fishing for flounder, shark, spot, and skate, and some commercial fishing in the spring for striped bass and shad. The total value of the annual catch rarely exceeds several thousand dollars (Maryland Landings, 1968).

In 1960 the Maryland Department of Research and Education conducted a project designed to test the hypothesis that bay fishing could be improved

1/ Compiled from catch records between 1890 and 1958.

by artificially modifying the bottom. In this study oystershell plantings were made on formerly productive bottoms, and fish were trapped in planted areas and control areas at different times through the year. About 77% of the fish caught were captured over the planted areas. During later years it was found that fish abundance became even greater over the planted areas (Arve, 1960). This possibility, coupled with the gradual return of eelgrass, may help to improve the Bay fin-fishery in the future.

Although the Bay does not at present support a valuable industry, it appears to serve as an excellent nursery ground for young of spot, weakfish, silver perch, summer flounder, anchovies, black sea bass, and others (Schwartz, 1961). Some of these fish will, in time, become directly available to the ocean industry, while others provide a food source for commercially valuable species.

Since 1939, when a permanent harbor was established at Ocean City, most of the commercial finfish activity has moved to the ocean, using Ocean City as a homeport. From 1957 to 1967 a large percentage of the catch, by volume, consisted of mixed or industrial fish used for reduction to meal and oil. In 1958 this catch ranked second in weight and fifth in value (Sieling, 1960). In 1965 industrial fish came into bigger demand as a local plant processing chicken feed expanded operations to processing fish caught along the Maryland-Virginia shore. Due to a ready market, the value of the industrial fish catch rose to \$516,530 in 1967. However, in 1968, the processing plant ceased to utilize industrial fish species, and there was subsequent catch reduction of over 6,000,000 pounds. In 1968 the industrial fish catch was valued at only \$259.00. (Maryland Landings, 1968). As the exvessel price for scrap fish is small,

the loss of this industry did not greatly reduce the total value of the ocean finfish industry. In 1967 edible fish constituted about 25% of the catch by volume, the remaining 75% being scrap fish. However, the edible fish catch constituted 91% of the total value of the catch. The edible fish industry produces a mixed catch, including such species as bluefish, butterfish, croaker, sea bass, gray trout, mullet, spot, whiting, and other less important fish. Despite considerable fluctuation from year to year in the number of pounds of any one species landed, the actual value of the total catch has remained about the same, or decreased only slightly, in recent years. Higher prices for some species, and larger catches of others has made this possible.

TABLE 5. OCEAN FINFISH LANDINGS AT OCEAN CITY, MARYLAND FROM 1958-1969.

	<u>pounds</u>	<u>value</u>
1958*	3,176,584	\$266,759.
59		
60	5,166,218	275,197.
61		
62	4,428,555	276,160.
63	8,650,548	514,464.
64	14,531,713	583,537.
65	15,791,259	441,801.
66	15,191,724	304,612.
67	7,990,914	349,664.
68	1,349,507	230,043.
69		
Jan.	5,659	657.
Feb.	11,779	4,795.
Mar.	107,756	15,699.
Apr.	180,060	13,558.
May	153,828	20,539.
June	101,268	20,021.
Jul.	53,480	15,409.

*1958 from Murphy, 1960.

1960-69 from Maryland Landings Annual Summaries, 1960-69.

TABLE 6. CHINCOTEAGUE BAY FINFISH CATCH FROM 1966-1968. Includes yields from bays and creeks that drain into the Atlantic Ocean.

Species	1966		1967		1968	
	lbs.	value	lbs.	value	lbs.	value
Alewives	41	\$ 1.	--	--	408	\$ 4.
Bluefish	289	15.	697	68.	132	16.
King Whiting	114	9.	614	54.	36	4.
Mullet	60	6.	--	--	1,355	136.
Shad	3,230	178.	--	--	779.	54.
Shark	210	5.	--	--	--	--
Spot	92	2.	4,552	591.	--	--
Striped bass	735	96.	309	89.	5,320	676.
White perch	642	43.	--	--	523	81.
Unclassified bait	6,000	180.	--	--	--	--
Scup	--	--	65	13.	--	--
Gray Sea trout	--	--	135	19.	145	9.
Fluke	--	--	--	--	89	26.
Hickory Shad	--	--	--	--	102	3.

From Maryland Landings Annual Summaries, 1966-68.

MINOR COMMERCIAL FISHERIES

In addition to the major commercial fisheries operating in the Chincoteague area, there are several smaller industries in operation, and several that may soon begin operation.

Several years ago, fishermen began catching lobsters offshore in black sea bass pots. Since then, lobsters have been caught in good numbers, usually about 4,000 to 8,000 pounds a year. Prior to a fire in 1969 that destroyed the landing facility at Ocean City, about 6,000 pounds of lobster a week were caught. Since then the catch has decreased, but when the facility is repaired, the industry will probably regain its former level and possibly expand (James Casey, personal communication).

Ten years ago, researchers reported that no bay scallops (Pecten irradians) were found in Chincoteague Bay. During the 1968-69 clamming season fishermen reported about 50 scallops a day were caught with their dredges in the area of Maryland-Virginia border. The size of the population has not been determined, but qualitative measurements indicate that their spread is from the vicinity of the line up to Green Run Bay only on the eastern side of the Bay. Their growth and spread appears to directly follow the re-invasion of eelgrass (Zostera marina) in the Bay. Scallops represent a potentially profitable industry in the future (Michael Castagna, personal communication).

Bloodworms (Glycera dibranchiata) are at present an untapped resource in Chincoteague Bay. These polychaete worms exist in large numbers in several areas, especially on the flats opposite Ocean City (Fr. James Casey, personal communication). As they command good prices at fishing centers

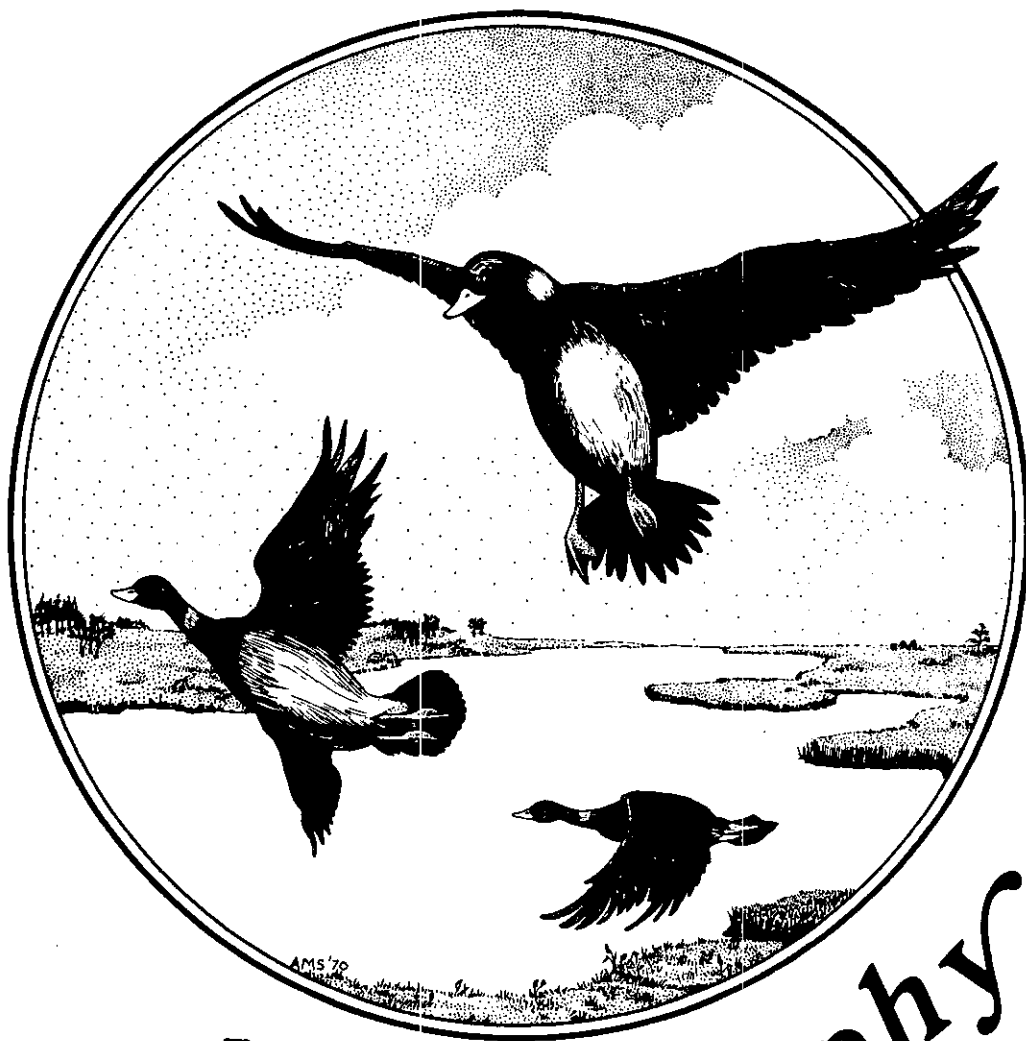
like Ocean City, the worms have the potential for supporting a small, but profitable industry.

Recently, a number of clammers have noted the presence of brown shrimp (Panaeus sp.) in the system. Several fishermen have indicated that they plan to catch them this summer. Occasionally, local people will catch grass shrimp (Paloemonetes sp.), which exist in great numbers, and sell them for bait at Ocean City or more distant areas (James Casey, personal communication).

Usually, some squid and conch are taken in the ocean and Bay. Although the number of pounds landed has generally decreased, the value of the catch has increased. The 1968 combined catch was valued at about \$16,000 (Maryland Landings, 1968).

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bibliography



K. A Bibliography of Natural, Political
and Historical Aspects of Assateague
Island, Maryland - Virginia and Vicinity

J. Mark Odell

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